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ABSTRACT

The predominant focus of the 24 Outdoor Biology Instructional Strategies (OBIS) Trial Edition Set III activities is on animal behavior, and the adaptations and diversity of both plants and animals. Night time activities, games, investigation, experimentation, and crafts are used to study ants, birds, clams, water snails, water striders, spiders, lizards, pillbugs, sow bugs, jays, and plants. The holding adaptations of water organisms, response of animals to varying light conditions, stalking, food preferences, and pigmentation are also investigated. The activities, organized in 24 separate, water-resistant folios, include introduction, preparation, materials, actions, follow up, and related activities. There are 3 additional folios. An "OBIS Tool Box" provides information for construction and use of simple equipment, such as a clam hoop, lizard rig, night shine flashlight, and sweep net, and explains game variations and craft methods. There is an order form for hard-to-locate materials. A "Survival Kit" for leaders contains sample combinations of activities from Sets I, II, and III to organize concept packages and skill units, as well as tips on safety, conservation, and site selection. "What is OBIS?" explains some major biological and environmental concepts embraced by the activities. (SB)

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OUTDOOR
BIOLOGY
INSTRUCTIONAL
STRATEGIES
TRIAL EDITION

SET III

No. 901 E. B.

RC 011 196

U.S. DEPARTMENT OF HEALTH,
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IT'S A BIOLOGICAL WORLD

We offer here explanations of some of the major concepts embraced by OBIS activities.

We are part of the ecosystem, which includes living organisms and the nonliving environment. Plants and animals, and their environment, affect each other and their environment. All parts of the ecosystem in some way. The study of these interactions between organisms and their environment is called ecology.

Food Chain

Energy input to the ecosystem comes from the sun. Through photosynthesis, plants transform the sun's light energy into food energy. Animals cannot make food; they must obtain their food by eating plants or other animals that eat plants. The energy in the food is transferred from plants to plant eaters and then to animal eaters. This energy transfer is called a food chain.

Natural Recycling

When organisms die, their bodies may be eaten by scavengers as diverse as worms and vultures. Plant and animal tissues not eaten by scavengers are consumed by molds, bacteria, and many kinds of small animals. In the process of obtaining food, these organisms decompose the dead organic matter and eventually reduce it to minerals, water, and carbon dioxide. These materials, returned to the earth, water, and atmosphere, can then be used again by plants to produce food.

clearing, swamp draining, construction), the new environmental conditions may no longer support the varieties of life that were previously present. Many organisms will therefore die. Some plants and animals that existed in the old environment may already have special features or characteristics (adaptations) that will allow them to exist in the new environment. Organisms previously unable to live in a certain habitat may now **colonize** it because the environment of that habitat has changed. These first colonizers may not be adapted to compete with some of the organisms that follow later. Many fail and are replaced by still other organisms.

Life Cycle

Every species must reproduce in order to perpetuate its kind. The process by which an organism comes into being, matures, and reproduces is called the **life cycle**. Some life cycles are short, as in the case of a mosquito which may go through its life cycle in a matter of a few days, while others are long, as in the case of some trees that may take years to mature and reproduce.

Humans

One organism that influences every ecosystem is man. Humans have a technology which enables them to survive in a wide range of environments and to gain dominance over many other life forms. Because of man's special abilities, he must assume responsibility for the consequences of his actions.

It is clear that the time has come for worldwide adoption of sensible management practices derived from an understanding of the ecosystem. OBIS provides one avenue for young people to develop this understanding.

Outdoor
Biology
Instructional
Strategies

Lawrence Hall
of Science
University of California
Berkeley, California
94720

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Combining several ORIS activities or folios into a module is best done by you, the leader. You know the children, their ages, and their interests, as well as the available activity sites, weather, time frame, group size, and materials budget. Sometimes activities obviously are not appropriate for a mountain camp site. Thus some selection is mandated by the activity site that is available. Also, you are in the best position to determine if an activity is too difficult for your group of youngsters.

For your convenience, however, we include the following suggestions for modules:

ADAPTATION

	Set
Back Pioneers	II
Insect or Animal	I
Seed Dispersal	I
Adaptation — Predator-Prey	I
Insect o Plant	I
Aftershock!	I
[redacted]	III
Animal Movement in Water	I
Water Breathers	II
Hold It	III

ANIMAL BEHAVIOR

	Set
For the Birds	III
Joy Ride	III
[redacted]	II
[redacted]	III
[redacted]	II
[redacted]	III
[redacted]	III
[redacted]	III
[redacted]	II
[redacted]	I
[redacted]	II

Water Striders	III
Night Shine	III

FRESHWATER

	Set
Water Holes to Mini-Ponds	I
What Lives Here?	I
Habitats of the Pond	I
Animal Movement in Water	I
Water Snails	III
Water Breathers	II
How Many Organisms Live Here?	I
Water Striders	III
Attract a Fish	II
Crawdad Grab	II
Hold It	III
Can Fishing	III
Great Streamboat Race	I

GAMES

	Set
Food Chain Game	II
Great Streamboat Race	I
Sound Off	I
Silent Stalking	III
Gaming in the Outdoors	II
Variation Game	III

HUMAN INFLUENCE

	Set
Out of Control	I
Can Fishing	III
Junk-in-the-Box	II
ORIS On Spot	I
Too Many Mosquitoes	II
Plants Around a Building	I
The ORIS Trail Mobile	

MAPPING AND DISTRIBUTION

	Set
Mapping a Study Site	I
Plant Patterns	I
Stalking	I
Scavenger Hunt	I
[redacted]	I
[redacted]	I
[redacted]	I
[redacted]	I

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Outdoor
Biology
Instructional
Strategies

MARINE ACTIVITIES

	Set
Rock Pioneers	II
Flocking Around	II
Beachcombing	III
Seas in Bottles	II
Beach Zonation	II
Animal Movement in Water	I
Marine Mud	II
Ocean Hopping	III
Night Shore	III
Oil Spill	II

FRESHWATER

	Set
What Else Lives There?	I
Pond Ooze	II
Plant Seeking	III
The Old Water Sweat Trick	II
Web of Life	III
Night Shore	III

SAFETY

The safety of your group is a prime consideration. In order to assure safety, OBIS designs equipment and procedures to be as safe as possible. In addition, OBIS recommends that leaders organize a **Buddy Safety System** when participants explore an aquatic or other potentially hazardous site. As a precaution, you may wish to bring along a first-aid kit.

Buddy Safety System

The **Buddy Safety System** is designed to insure that no participant will ever be far from assistance or out of the reached. Group members choose a "Buddy" they would like to work with. For an odd-numbered group, organize one team of three buddies. When the youngsters are paired off, tell them that each individual is responsible at all times for the whereabouts and safety of his buddy. No one should never leave his buddy's side unless the buddy is threatened. In the event of an emergency, one buddy, the other buddies should assist and call for help.

Other Hazards

Avoid aquatic sites with obvious hazards such as steep banks and slide areas. Look for a site with gently sloping banks for easy water access and unobstructed vision for easy supervision.

CONSERVATION — TAKE 'EM BACK ALIVE

Your youngsters should understand that organisms should be returned to their habitats. OBIS asks that temporarily be observed and all should be returned to the area found. If any organisms are exceptions (The overall an activity site and rules of procedure for the ecosystem and

SITE SELECTION

Make sure your selected everyone in the group small enough to allow group. Be familiar with and the participants have

Secure permission to use the site if permission is required. Familiarize any rules of procedure that apply to the the site. Some sites, particularly parks, areas are protected by strict rules against interference with living organisms. Make sure youngsters understand and follow the

nail polish
VINEGAR
NO MATCH
1.
2.
3.
4.
5.

ACETONE
NO MATCH
1.
2.
3.
4.
5.

Equipment Card
AQUATIC OBSERVATION AIDS

Bug Boxes

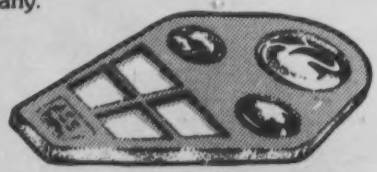
A bug box is a small, clear plastic box with a magnifying lens for a lid. To use the bug box, place an object or organism in the box and replace the lid to magnify the contents. When exposed to direct sunlight a closed bug box heats up rapidly, so release organisms promptly after observing them. The lid can also be used separately as a magnifying lens.

Dip Nets

Nets can either be made or bought. Aquarium nets work fine. You may want to extend the reach of an aquarium net by attaching a dowel, a stick, or a similar extension to the handle. A gradual, gentle scoop of the net is usually more successful and less damaging to organisms than a sudden, violent scooping motion. To prevent eye accidents, ask that the nets never be raised above shoulder level.

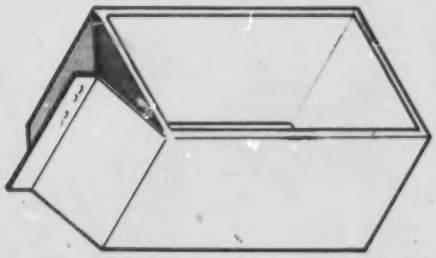
Magnifying Lenses

To use a magnifying lens, hold the lens close to one eye and move either your head or the object back and forth until you can see the object clearly.

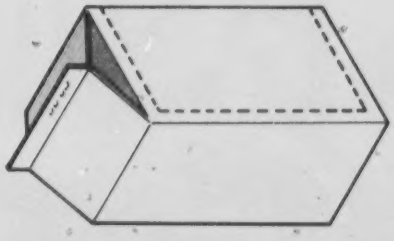


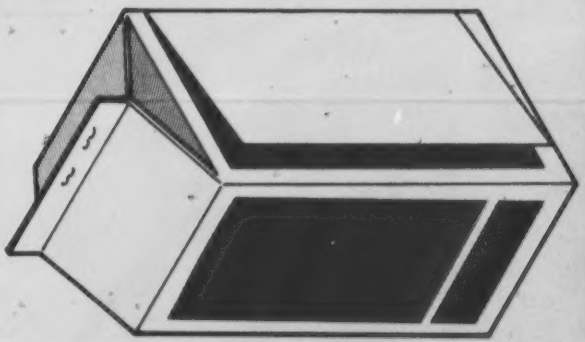
Observation Chambers

Any container that will hold water can serve as an observation chamber. Containers with light-colored bottoms are best for easy viewing of organisms that have been added. Half-gallon milk cartons can be made into deluxe observation chambers. To make one, staple the pouring spout closed and cut out the carton wall on the same side as the stapled pouring spout.



To make a hinged-top observation chamber, just cut along three sides (two short and one long) of the carton wall on the same side as the stapled spout.





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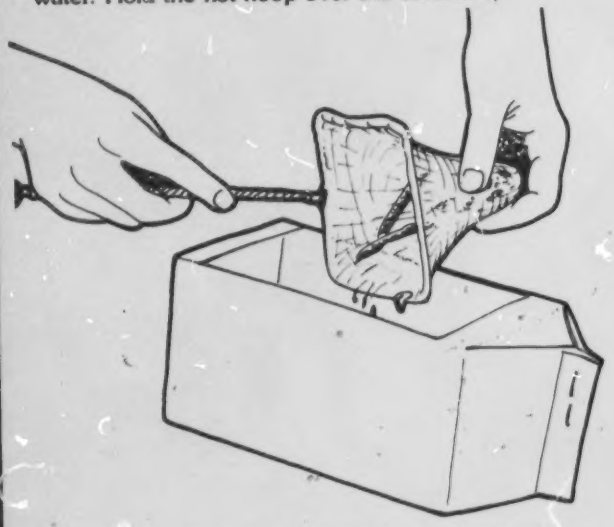
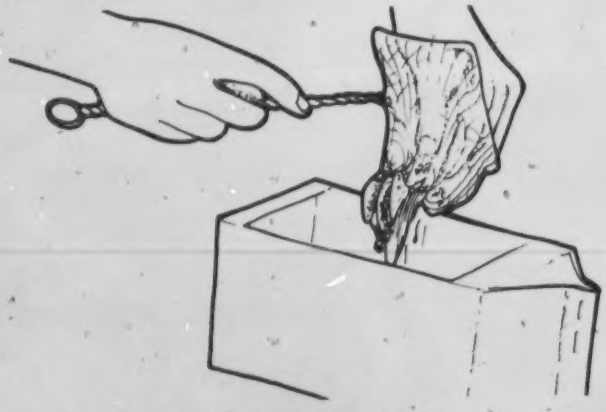
Transferring critters to observation chambers. When using a net to transfer critters, first swish the net through the water without releasing the organisms. (You can use the pond or stream you are investigating.) The rinsing removes any sediment you may have netted. Fill your observation chamber about one-third full of water. Hold the net hoop over the container,



turn the net inside out, and dip the net bag into the water in the container.

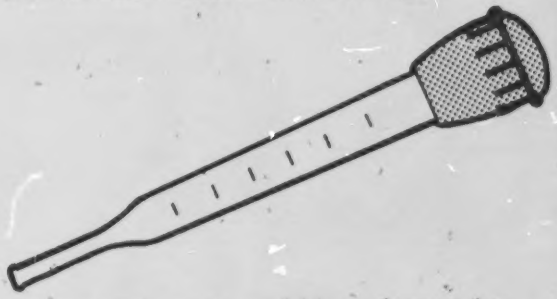


This will release netted organisms into the container.

Spoons and Clear Plastic Cups

Spoons and cups are useful for transporting tiny organisms and observing them at a close range.

Simply dip up tiny organisms with a spoon or cup and place the organisms in a container partially filled with clear water. Turkey basters (giant



dropper type) are also useful for sucking up tiny organisms and transferring them to other containers.

Note: Certain hard-to-get materials are available from the Lawrence Hall of Science. See the order form in the *OBIS Toolbox* folio.

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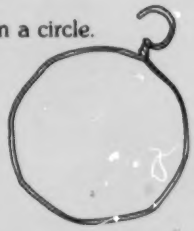
Can Fishing
Equipment Card
CAN GRABBER

MATERIALS:

1 wire coat hanger
1 pole (a broom handle or wooden dowel one- to two-meters long)
1 roll of masking tape or filament tape
1 empty 12-ounce can

TO MAKE A CAN GRABBER:

1. Bend a coat hanger to form a circle.



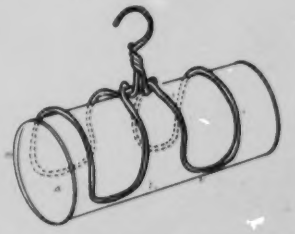
2. Grab the hook with one hand, and the wire across from the hook with the other hand, and force the hook under the other side to form a giant pair of glasses.

3. Twist the hook around the center wire to secure the shape.

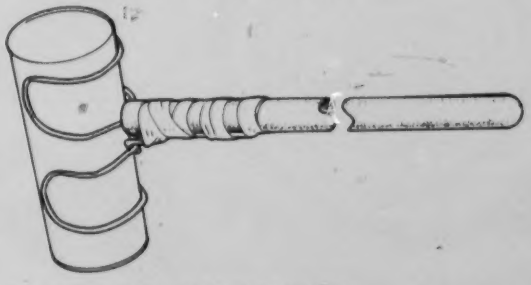
4. Flatten out "eyes" to form an "H".

5. Bend flattened "eyes" into arches that match the circular outline of a 12-ounce can lying on its side.

6. Use the 12-ounce can to adjust the tension of the curved arms so that they hold the can firmly when they are pushed onto the can.



7. Straighten out the hook and securely tape the wire shank to the extension pole.



TO USE THE CAN GRABBER:

You have to push the Can Grabber down onto a can in order to "grab" the can. For this reason, the Can Grabber works best from docks or boats or when wading. Once you have grabbed a can, keep the can in a horizontal position as you raise it or the can will slip out of the Grabber. The Can Grabber also works on bottles that have about the same diameter as the 12-ounce cans.

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Clam Hooping
Equipment Card
CLAM HOOP

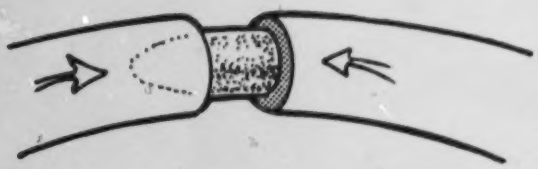
PLUG METHOD

MATERIALS

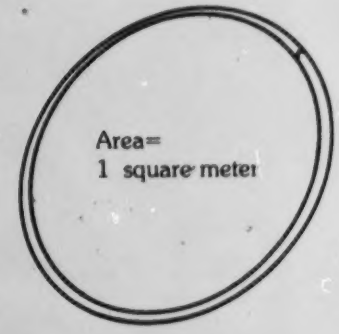
1 piece of old garden hose, 3½ meters long
1 small wooden plug

old garden hose

small wooden plug



Tightly jam plug into both hose ends.

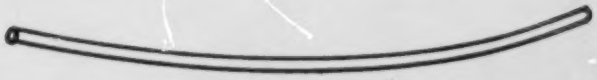


Completed clam hoop

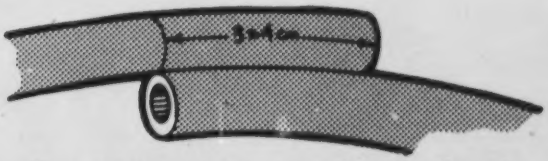
TAPING METHOD

MATERIALS

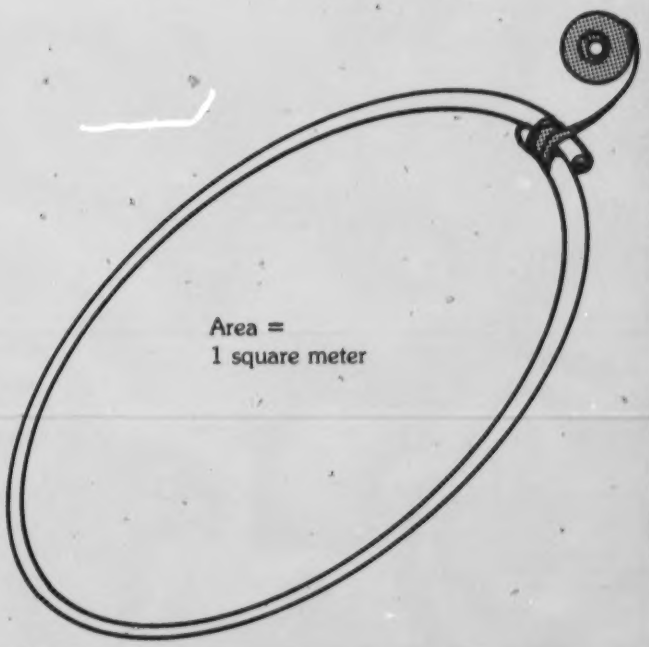
1 piece of old garden hose, 3½ meters long plus 6 to 8 centimeters extra for overlap
- tape



Overlap the ends 3 to 4 centimeters.



Then tightly wrap tape around the overlapped ends to secure the hoop.



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Variation Game
GAME RULES

The best way to explain the various game rules is to play each game with one child while the other kids watch you. Many kids are already familiar with some of these simple, two-person games. Feel free to change or adapt rules as you wish. In each game, the winner retains control of the resource card. The loser must challenge another monkey in order to get his or her own resources.

The letters used in the game descriptions are **C** for Challenger and **D** for Defender.

ROUND ONE

Pulling Roots (Tug of War)

1. **C** and **D** grab opposite ends of a knotted three-meter length of rope.
2. The rope is centered over a mark on the grass.
3. When both monkeys are ready, each tries to pull the other monkey over the mark.
4. The winner has succeeded in pulling food out of the ground. The loser must search for food elsewhere.

Jumping to Escape (Standing Broad Jump)

1. **C** and **D** agree on a starting point and mark that point with a toothpick.
2. **D** stands with his toes just touching one edge of the toothpick.
3. **C** plays the attacking monkey and roars, causing **D** to leap as far as possible. Use a toothpick to mark where **D's** heels (or hands, if he falls backwards) ended up.
4. The monkeys reverse roles.
5. The monkey who jumped farthest escapes with the food (wins a toothpick). The other monkey must challenge another monkey.

Wrestling (Arm Wrestling)

1. **C** and **D** lie on the grass with one elbow forward and resting on the ground. **C** and **D** grasp each other's forward hand.
2. When both are ready, each tries to pin the other's arm back to the ground.
3. The loser must challenge another monkey for food or starve.

ROUND TWO

Building a Shelter (Threading Bolts)

1. **C** and **D** each take a bolt in one hand and three nuts in the other hand.
2. When both are ready, they start threading all three nuts onto their bolts. The threading represents constructing a nest.
3. The first to thread the nuts all the way to the bolt head has successfully constructed a nest. The loser is exposed to predators and rain.

Swatting Mosquitoes (Palm Slap)

In this game, **D** is a monkey and **C** is a mosquito. The youngsters alternate roles until one has won twice in the **D** role, i.e. until as a monkey one youngster has swatted two mosquitoes. The challenged party has her choice of starting as a monkey or a mosquito.

1. **D** stands with hands held forward, palms up.
2. **C** faces **D** and holds her hands palms down just above **D's** palms.
3. **D** wins if he is able to move his hands quick enough to slap the top of **C's** hand or hands (the mosquito) before **C** can pull her hands out of danger.
4. **C** wins if she is able to pull her hands back out of danger before **D** slaps them.

Catching Termites (Threading Needles)

1. **C** and **D** take a needle card in one hand and a piece of thread in the other.
2. When both are ready, they start trying to thread the needle, i.e. push a straw into the termites' nest entrance.
3. The first to succeed sits back with a full stomach (wins). The loser goes hungry and must search elsewhere for food.

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ROUND THREE

Stare Down

1. Two monkeys face each other about one meter apart with eyes open.
2. With heads held still and no swinging of hands, each monkey stares intently into the other's eyes, tells jokes, yells, growls, etc., to get the other to blink.
3. The monkey who goes longest without blinking wins this simple confrontation over resources. The loser searches elsewhere for resources.

Hand Game

1. Monkeys face each other and count: "One, two, three," raising and lowering a hand at each count.
2. On the count of three, each monkey makes either a rock (closed fist), paper (open palm), or scissors (closed fist with forefinger and middle finger held out and apart). Rock breaks (wins) scissors, scissors cut (wins) paper, paper covers (wins) rock.
3. Replay ties, such as both monkeys gathering rocks at the same time.
4. Play until someone wins two out of three tries.

Palm Push

1. Two kids face each other about 40 centimeters apart with their hands held chest high, palms forward, slightly wider than each person's shoulders.
2. When both are ready, each tries to get the other to move his feet by:
   a. Hitting the other's palms (palms only) hard enough to knock him off balance or . . .
   b. Relaxing her arms (faking her opponent out) as he hits her palms, causing him to lose his balance.

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Hold It

Equipment Card
HOLD-IT TROUGH

MATERIALS FOR ONE TROUGH:

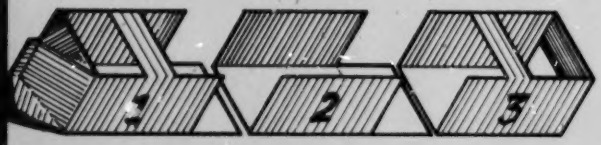
3 half-gallon milk cartons
1 sharp knife

1 stapler*
1 roll of waterproof tape (Mystic tape or duct tape)*

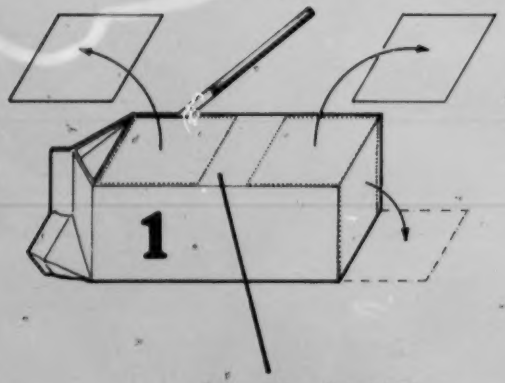
*These materials can be shared among the teams.

CONSTRUCTION OF THE TROUGH

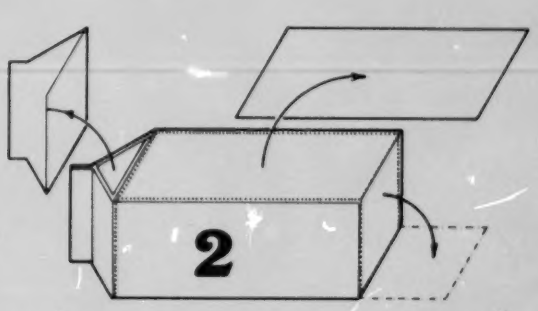
The trickiest part is cutting the cartons. (For safety reasons, the leader should cut the cartons.)



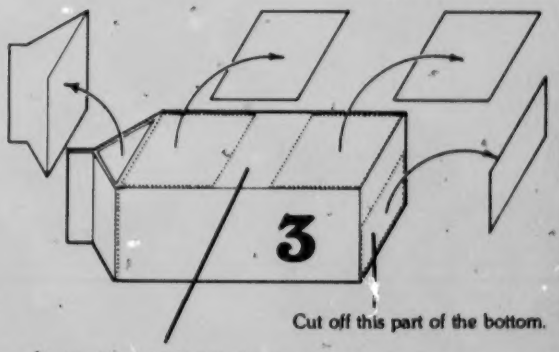
Carton #1
With the spout side *DOWN*, cut two windows in the top, then cut the bottom loose so it flaps down.



Carton #2
Cut off the spout end and throw it away. Cut off one side and throw it away. Cut the bottom and flap it down.



Carton #3
Cut off the spout end and throw it away. Cut out two windows and throw them away. Cut the *lower half* of the bottom out. Make sure the half you cut is the one without the windows.



Assembling the Three Cartons
Slip carton #2 part way into carton #1. (The edges of carton #1 should overlap with the edges

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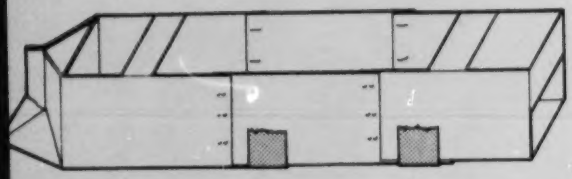
of carton #2 about two centimeters.) In the same way, slip carton #3 into carton #2.

Staple sides where cartons overlap and securely *tape* bottom flaps down.



There! You have a Hold-It Trough.

USE OF THE TROUGH

To use the trough, you will also need:
1 aquarium net
1 small plastic cup

The trough is a tool to use in investigating the ability of various aquatic organisms to withstand the force of currents. Here is how you use your trough:

1. Capture some stream critters and put them in a cup.
2. Install your trough in a shallow portion of stream. The cut-out bottom of Carton #3 should be upstream and the spout downstream. The current should run through your trough.
3. Choose the bottom material you want and arrange it in the bottom of your trough.
4. Put your net over the spout to catch any creatures that don't hold on.
5. Dump your stream creatures into the trough near the end where water enters the trough.
6. Observe how, where, and the speed at which different creatures grab hold.
7. Vary the speed of the trough currents by trying the trough in different areas.
8. Trough currents can be created artificially by dumping water just above the trough.

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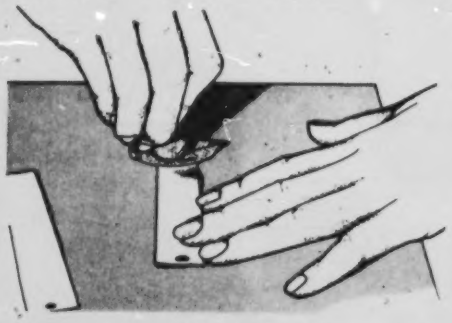
Pigment Puzzles

Technique Card

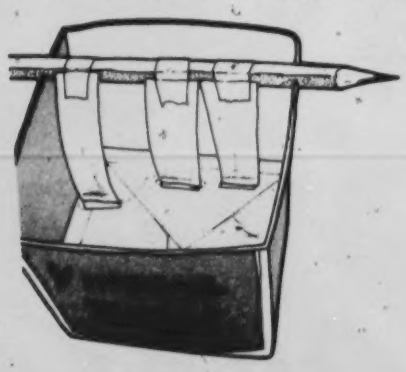
HOW TO MAKE A PIGMENT PRINT

1. Fill the containers to the 1-cm level. Cover the cartons containing acetone with the plastic-wrap lids.

2. Transfer the plant pigment to the filter paper strip. Place the sample 1.5 cm from the bottom of the strip (on the horizontal pencil line). Roll the edge of the coin over the sample just hard enough to crush the plant sample. Place a fresh part of the sample under the coin and repeat the procedure in the same spot. Repeat three more times to transfer as much pigment as possible. Let the color dry on the strip of paper.



3. Tape the top edge of the strip to a pencil. You can tape three strips to one pencil. Carefully lower the paper into the liquid, making sure that the pigment mark stays above the liquid. After making necessary adjustments with the tape, rest the pencil in the carton notches. *Remember, the pigment mark must not touch the liquid.*



The liquid will move up the paper, carrying the pigments with it. The different characteristics of the pigments will cause them to stop rising at different positions on the paper. Making a print takes about seven minutes.

4. Each liquid will not work with all the pigments. When both liquids *do* work on the same pigment, they will move the pigment at different rates. In general, the acetone separates pigments in leaves, and the vinegar separates pigments in fruits and flower petals. You will find exceptions. Don't be disappointed by one failure; try the other liquid or another plant part.

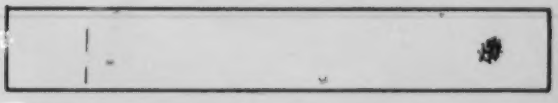
5. Tape an identifiable piece of the plant sample to the top of the paper strip so the pigment print and sample remain together.

MAKING THE PIGMENT PUZZLES

1. Cut the coffee filters into strips 1.5 cm by 10 cm.

2. Prepare fifteen strips for each team and ten to fifteen for the pigment puzzles.

3. To eliminate confusion, place a marking pen dot at the top of half of the strips. Dotted strips will be used in acetone, all others in vinegar.



4. Draw a horizontal pencil line 1.5 cm from the bottom of each strip. Plant pigments will be pressed onto the paper at this line.

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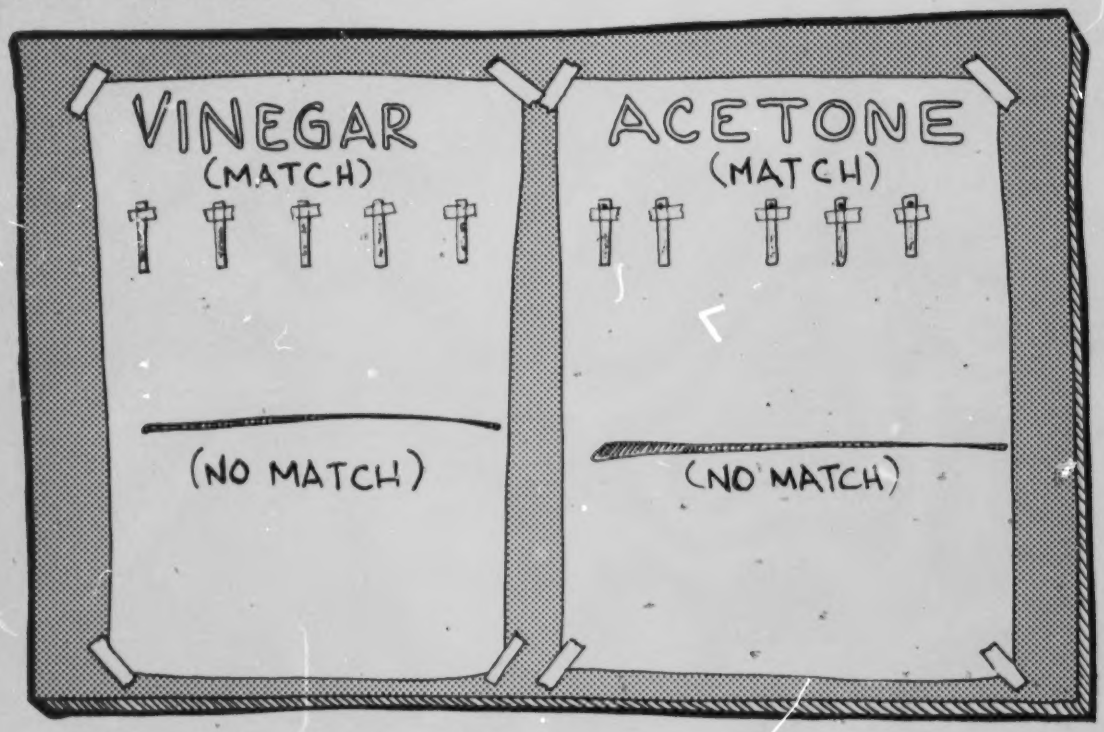
5. Collect five plant samples from your activity site. (A sample might be a stem, leaf, berry, or a single flower petal.) Collect different parts of the same plant as well as samples from several different plants. Prepare pigment prints of these five samples using both acetone and vinegar (total of ten pigment prints in all). You might try more than five plant samples and select those five samples that give the most interesting prints.

6. Prepare two pigment-puzzle boards, one labeled "acetone" and one labeled "vinegar."



Tape the pigment prints in the same order to each of the data boards. Mark off a "no match" section on each board.

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Leapin' Lizards
Equipment Card
LIZARD RIG

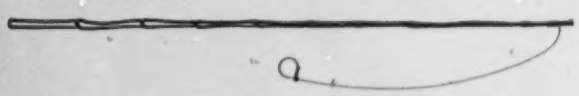
MATERIALS FOR ONE LIZARD RIG:

1 thin pole (stick, cane, fishing rod, or twig 1½ to 2 meters long)
1 half-meter length of fine wire (#36 to #50)* or light fishing line (2 to 4 lb. test monofilament)

* Available at most hardware stores.

ASSEMBLING THE RIG

Securely attach a half-meter length of light wire or fishing line to a fishing rod, bamboo pole, or other thin stick.



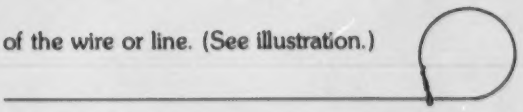
Wire can be obtained from household electric cord. Cut off about a half-meter length and pull the wire bundles out of the rubber insulation. Carefully pull the strands apart to obtain individual wires. Wire is easy for kids to use because they can twist lures on and off easily. Lures have to be *tied* to fishing line.

USING THE RIG

Feeding behavior. To explore feeding behavior, twist likely lures onto the wire (or tie to fishing line) and carefully present the lure to a lizard.

Encourage the group to try a variety of lures. After a few times the kids should learn that a quiet approach, tiny lure size, and lure movement are the keys to attracting lizards.

Lizard-to-lizard interactions. To investigate interactions, cut the wire or line so that about 30 cm remain. Tie a sliding noose on the free end of the wire or line. (See illustration.)



To noose a lizard, open the sliding noose until it is slightly larger than the lizard's head. Approach slowly until you can reach the lizard with the noose. Move the noose over the lizard's head, then give a gentle upward jerk to capture the lizard. Quickly swing the captured lizard onto your forearm or thigh to support the lizard. To tether your captured lizard, gently hold the lizard against your arm or leg with a flat open hand and then grasp the lizard behind the head with your thumb and first two fingers. (See illustration.)

In this position a lizard can't bite. Loosen the noose and move it down until it is just in front of the rear legs and gently pull it snug to tether your lizard.

Carry tethered lizards by letting them *cling* to a clothed part of your body (forearm, chest, etc.) as you walk about.

When you locate a free lizard, gently swing the tethered lizard down near it.

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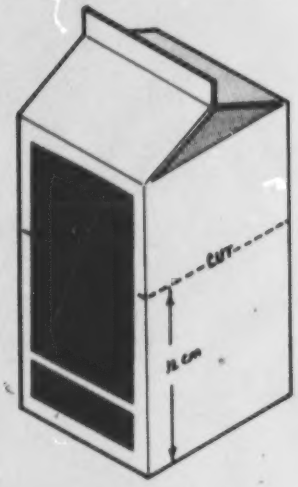
Pigment Puzzles

Equipment Card
MILK-CARTON CONTAINERS

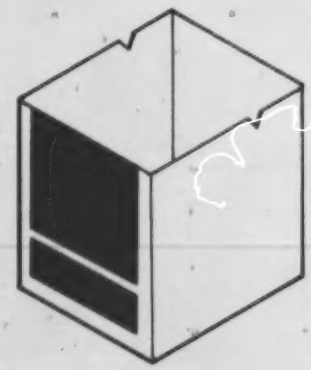
HOW TO MAKE MILK-CARTON CONTAINERS:

Prepare two milk-carton containers for each team.

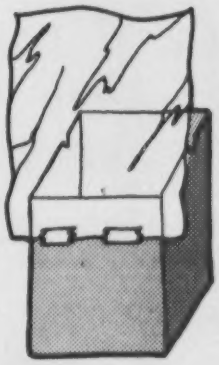
1. Cut off the top of the carton 12 cm from the base. Make a mark inside the carton 1 cm from the bottom.



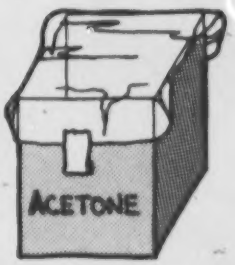
2. Cut two small notches in the top edge near the back of the carton to hold the pencil.



3. Cover the open top of one carton with clear plastic wrap, securing it with tape on the back. A small piece of tape on the front will serve as a latch. This cover will minimize the inhalation of fumes from the acetone.



4. Label this carton "acetone" and the other "vinegar."



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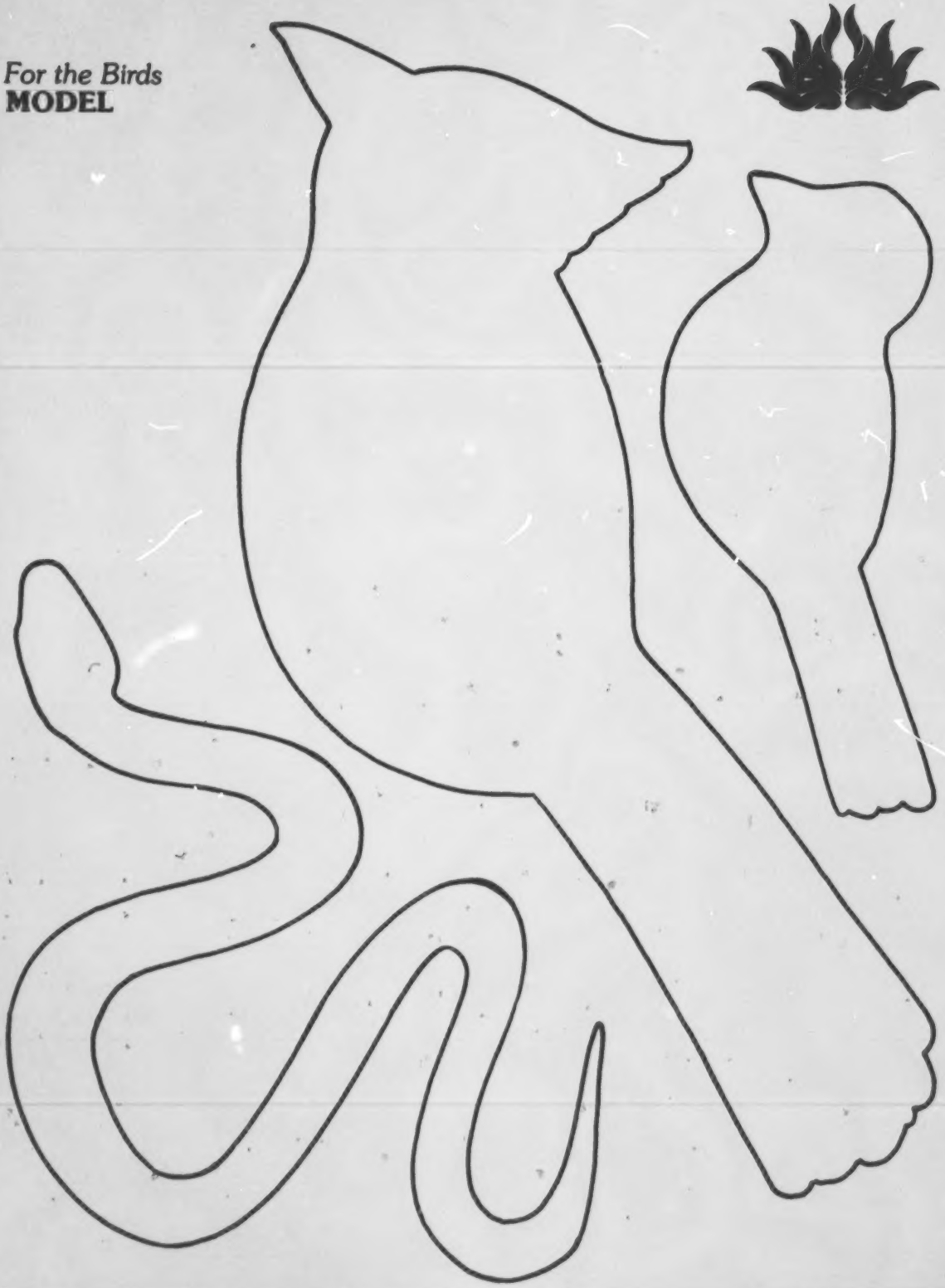
For the Birds
MODEL



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Night Shine
Equipment Card
NIGHT-SHINE FLASHLIGHT

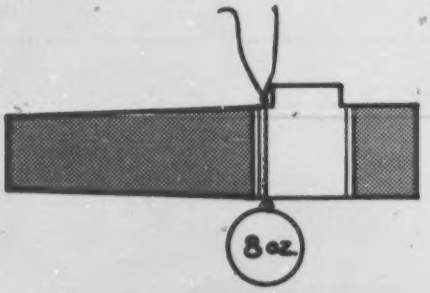
MATERIALS

For each Night-Shine Flashlight you will need:
1 waterproof flashlight (See **THE WATERPROOF FLASHLIGHT** section.)
1 6- to 8-oz. sinker (Choose a weight heavy enough to sink the flashlight.)
2 to 4 meters of braided fishing line (20 to 40 lb. test) or strong string
1 strip of electrical tape

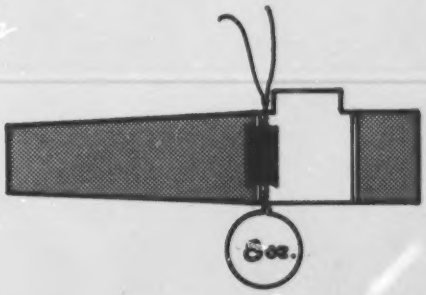
HOW TO RIG THE FLASHLIGHT WITH LINE AND WEIGHT:

1. Cut off a 30- to 40-cm piece of line. Tie the sinker to the middle of this piece.

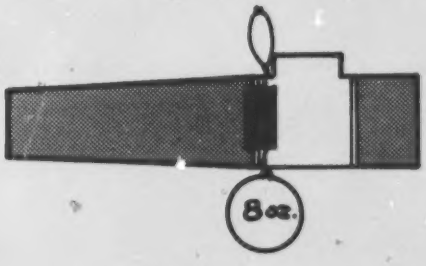
2. Wet the line to prestretch it. Then tie the line and sinker tightly around the flashlight. Position the sinker in such a way that the flashlight is horizontal when placed in the water. "Skipper" flashlights stay horizontal when the sinker is attached just behind the switch. (See **THE WATERPROOF FLASHLIGHT** section.)



3. When the sinker has been positioned properly, dry off the flashlight and tape the line in place to keep it from sliding.



4. Tie the loose ends of the line together to make a loop so the rest of the line (safety line) can be attached.



NIGHT SHINE TECHNIQUE

Launching the light. Select a calm, accessible spot, preferably close to shore where the water is shallow. Tie the long safety line to the flashlight, turn it on, and place it a few centimeters under the water. (In most cases this means the flashlight will be sitting on the bottom.) Secure the line to keep the flashlight from drifting away.

Sampling the "light" water. With dip net in hand, closely observe the water that is illuminated directly in front of the flashlight. Whenever an

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animal enters the illuminated water, try to net it. Every thirty seconds or so sweep the net back and forth through the illuminated water even if no animals are spotted. After each series of sweeps, turn the net inside out over the "light" container and dip the end of the net into the water in the container.

Note: Animals will often be captured that weren't observed beforehand. Kids, however, usually won't sweep their nets through the water unless they see something moving. Ask them to sample the illuminated water periodically even if they don't see any movement.

THE WATERPROOF FLASHLIGHT

Basically, you have two choices for a waterproof flashlight:

1. A commercially available flashlight such as the Eveready "Skipper."
2. A homemade waterproof flashlight (wrapped in two plastic bags).

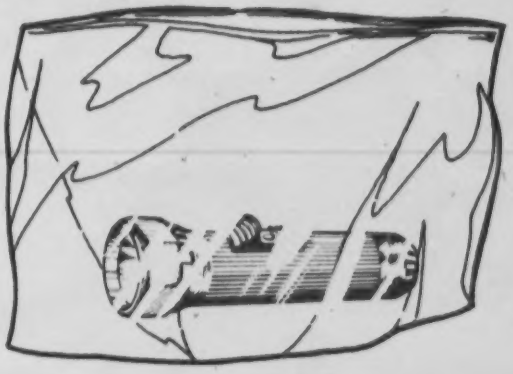
Homemade waterproof flashlights have several disadvantages. Waterproofing is time consuming and traps air so that more weight is required to sink the flashlight. The added layers of plastic also reduce the flashlight's brightness. If you can't obtain commercial waterproof flashlights, however, homemade ones will work adequately.

WATERPROOFING A FLASHLIGHT

You will need:
1 flashlight
2 zip-lock bags (wide enough to hold the flashlight sideways)
2 rubber bands

HOW TO WATERPROOF:

1. Place the flashlight in one bag and roll the bag around the flashlight to squeeze out the extra air. Then seal the bag.



2. Place the bagged flashlight into the second zip-lock bag and repeat the rolling and sealing procedure.
3. Use rubber bands at each end to keep the zip-lock bag from unrolling.

4. Follow the same line and weight-rigging instructions outlined above.

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Silent Stalking

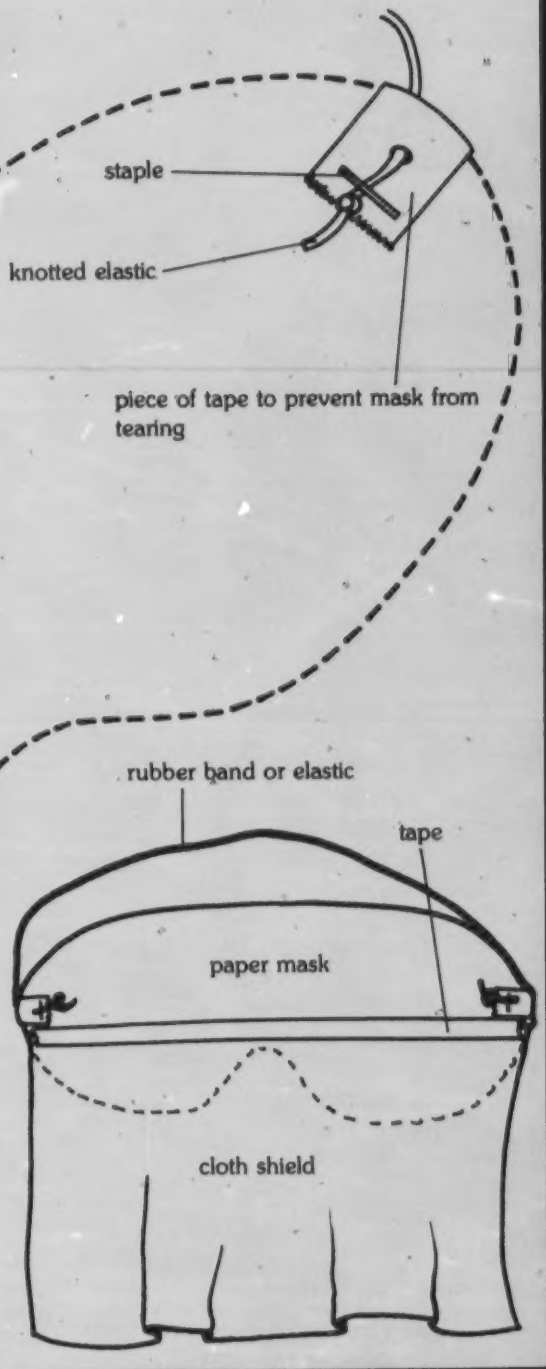
Equipment Card
OBIS MASK

MATERIALS

1 mask (cut out from heavy paper)
1 stapler
- tape
- cut rubber band or piece of elastic
- cloth for shield
- pencil or sharp object for punching holes

MAKING YOUR MASK

1. Trace the mask outline below to make a pattern.
2. Cut a mask out of a manilla folder, construction paper, or other card stock.
3. Reinforce the elastic attachment area with a couple pieces of tape.
4. After pulling the elastic through the holes, tie a knot at each end of the elastic.
5. Staple the elastic to the mask as shown.
6. Tape on a cloth shield across the front.



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Shake It!

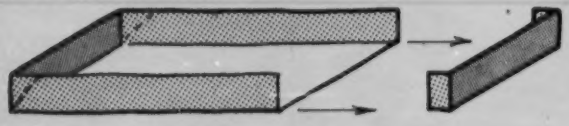
Equipment Card
SHAKE-IT CONTAINER

MATERIALS FOR ONE CONTAINER:

- 1 small, flat box
- 1 piece white paper (optional)
- 1 plastic bag
- tape

CONSTRUCTION:

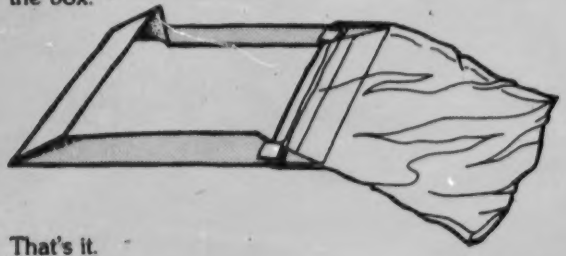
Get some small, flat boxes and cut one *end* out. One-ream standard 8½" x 11" paper boxes are perfect.



If the bottom is smooth and light colored, fine. If not, tape some white paper in the bottom.

Now put the open end of the box a short distance into a plastic bag. Supermarket produce bags work well.

Tape the bag in place on the *bottom* and *sides* of the box.



That's it.

To use the Shake-It Container:

Simply hold open part of the box under some foliage and shake the *foliage* vigorously.

Things that fall into the box can be tipped immediately into the bag. Critters that hold on can be tapped or gently scraped into the bag with a 3" x 5" card.

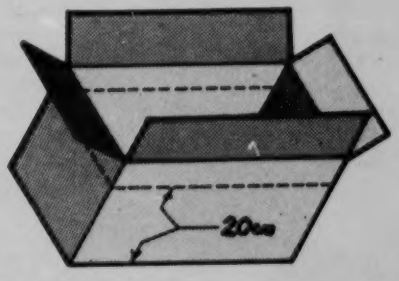
Returning the box to the level position puts a bend in the bag, preventing captured critters from escaping. In this way, you can make many "shakes" and transfer the catches into the bag.

To empty the bag, take it off the box and dump the contents. To reuse, retape the bag to the box.

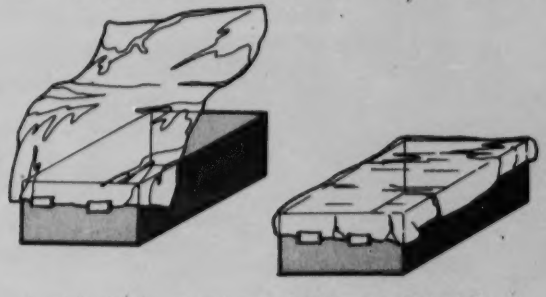
VIEW CHAMBER

CONSTRUCTION OF VIEW CHAMBER:

1. Get a box about 30-cm wide by 50-cm long.
2. Cut box off at 20 cm.



3. Tape a piece of plastic to one edge of box.



4. Pull plastic over top to hold animals inside.

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Variation Game
STORIES

ROUND ONE

The climate of the world you live in is similar to that of this area. Your source of food is roots of large shrubs, which you pull from the ground. While feeding, you must be alert for other monkeys that will try to take your food from you. If the monkey attacks you, you must jump quickly away to escape with your food. If you can't escape by jumping, you must wrestle to escape.

Games: Pulling Roots, Jumping to Escape, Wrestling

ROUND TWO

The world is becoming tropical: warmer with a high rainfall. At night you must have a shelter to protect you from the soaking rain. Increasing numbers of rain puddles are providing more homes for disease-carrying mosquitoes. When a mosquito lands on you, you must quickly swat it or you can become infected with malaria. One of your favorite foods is the termite, which lives in a tall, sturdy nest. To catch termites you must find long blades of grass to poke into the nest's small passage ways.

Games: Building a Shelter, Swatting Mosquitoes, Catching Termites

ROUND THREE

Your world has changed. Humans have built homes in the area you once lived in. Some of the resources you need to survive are now gone, covered by houses and roads. (Note to leader: To represent this loss, remove two resource cards from the lawn. You will now have two extra monkeys to challenge the ones in control of the resources.) You are now forced into greater competition with other monkeys for the few remaining resources. You first attempt to stare down your opponent by looking ferocious. If that doesn't work, you resort to a ritualistic hand game. Your final method of outwitting your opponent is to push him off balance.

Games: Stare Down, Hand Game, Palm Push

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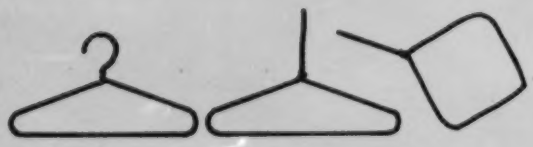
Web It!

Equipment Card
SWEEPNET

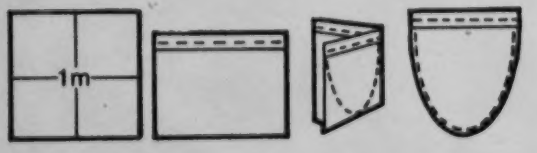
MATERIALS:

1 or 2 wire coat hangers (strong wire)
1 stick (approximately 1 meter long) for your net handle
1 piece of cheese cloth or netting for the net bag (about 60 cm by 90 cm)
1 needle and thread for sewing (or a sewing machine) or 1 stapler
• strong tape to attach net to handle

1. **Preparing the hoop.**
Take a strong wire coat hanger, straighten the hook, and pull the hanger into a square. (Use two hangers for added strength.)



2. **Preparing the bag.**
Your net should be almost one meter in circumference at the top, tapering down to a point. A sewing machine speeds up construction, but older kids can hand sew the nets if sufficient time is provided. Sew like this:

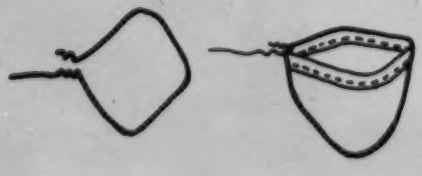


Fold one edge down 10 cm and sew.

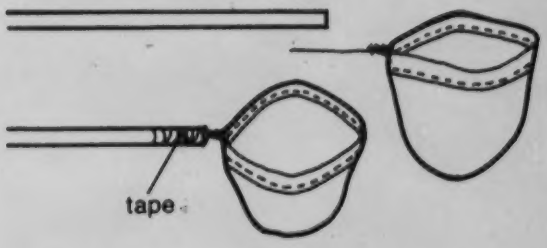
Fold in half and sew or staple.

Cut off excess.

3. **Assembling the net.**
Open the wire square and thread on the net.



Attach wire hoop to stick



4. **Using a sweepnet.**
While a sweepnet can be used to pursue and capture an animal that has caught your eye, this is not the most efficient method of use. A sweepnet is best used as a random sampling tool. You walk at moderate speed across the grassy area, sweeping the net back and forth, keeping it close enough to the ground to brush the weeds or grass. The net should just brush across the top of the grass. The idea is to sweep any animals that are buzzing around or resting on plants into the nets, so you must turn the net in your hand to capture animals on both right and left swings of the net. After you have made fifteen to thirty swings of the net, flip the end of the bag over the wire frame to keep the catch from escaping.

How to transfer animals from net to observation bag:

A. Pinch the net closed, keeping the animals in the bottom of the net.

B. Turn net inside out while holding animals.

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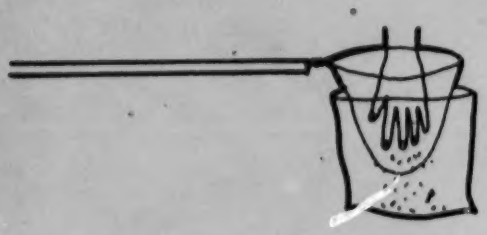
C. Place net in plastic bag, release and shake animals into the bag.



D. Grab top of bag.

E. Twist the top a couple of times and tuck the top under your belt or into an open pocket while you continue to sweep.

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Clam Hooping
Technique Card
USE OF THE TIDE TABLE

With a tide table (available from boating, fishing, and diving shops), you can look up the tidal conditions in your area for any time of any day. Leaf through your table. You may see a range of tides from minus one or two feet to plus six or seven, depending on where you are. Areas may differ, but the range will be consistent month after month. From this information you can determine the vertical height of the intertidal zone. (Subtract the lowest low from the highest high.)

You will need to determine the amount of intertidal zone exposed during your activity. Let us say that in looking in the tide book for the day and time you wish to investigate, you find that the tide is two feet. This means that the upper four to five feet of the intertidal zone are exposed.

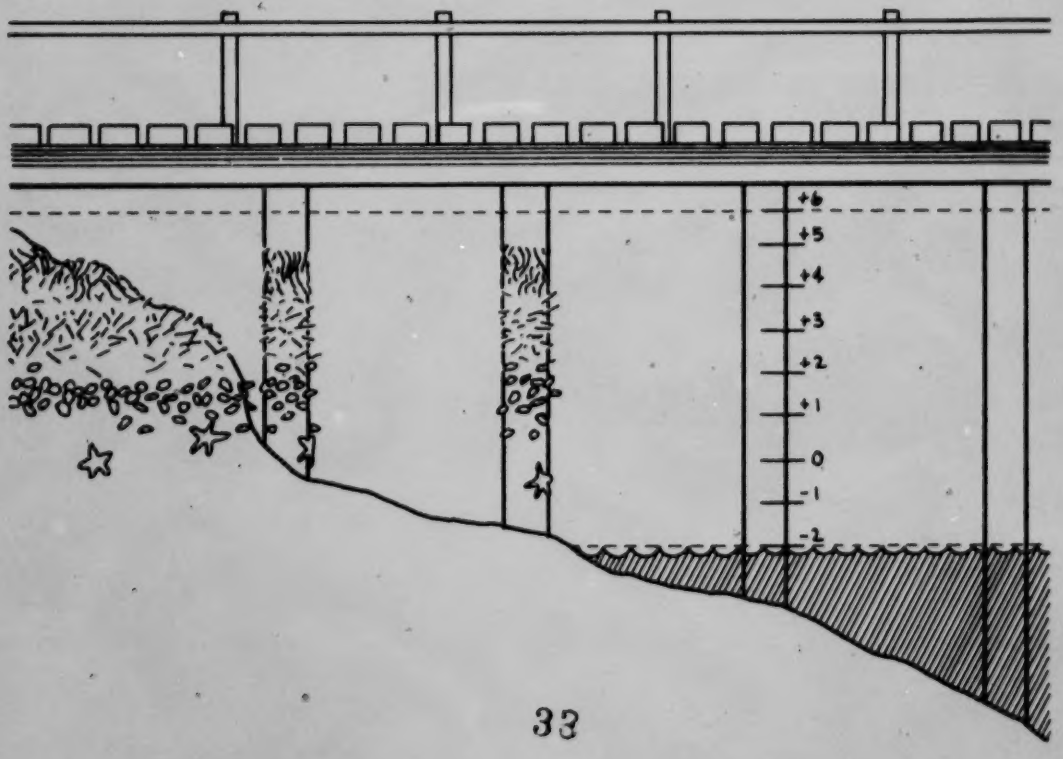
If it is not a high or low tide when you want to study your coastal community, you will have to estimate the height of the tide.

Example: You meet your group at 10:00 a.m.

The tide table reports:

Low Tide:	6:53 a.m.	1.5′
High Tide:	1:10 p.m.	5.1′

10:00 a.m. is about half way between 6:53 a.m. and 1:10 p.m., so your tide will be about half way between 1.5′ and 5.1′ or about 3.2′, and coming in (flood tide). After 1:10 p.m. the tide will be going out (ebb).



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Web Weavers

Technique Card, Side 1

WEAVING WEBS

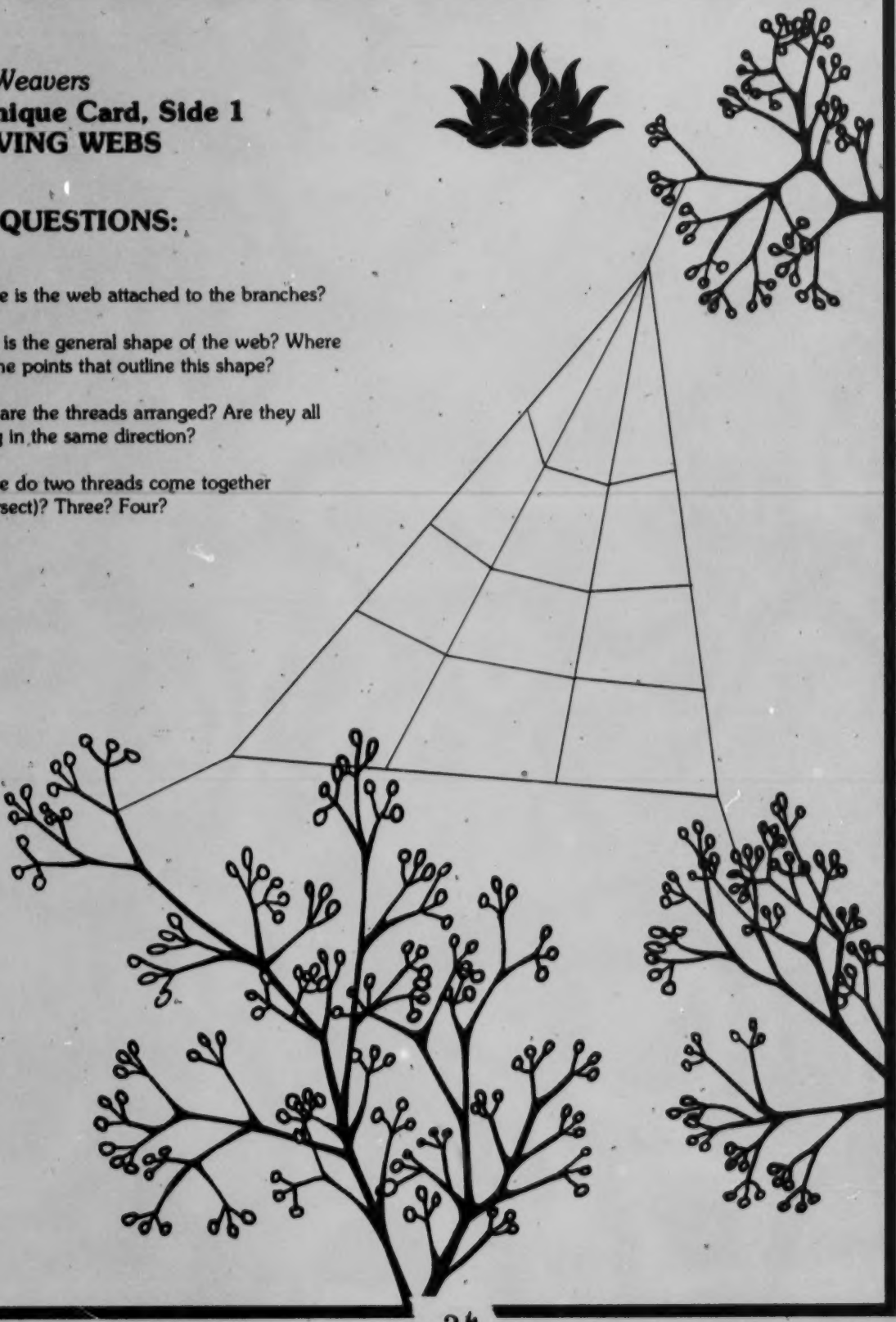
KEY QUESTIONS:

a. Where is the web attached to the branches?

b. What is the general shape of the web? Where are the points that outline this shape?

c. How are the threads arranged? Are they all going in the same direction?

d. Where do two threads come together (intersect)? Three? Four?



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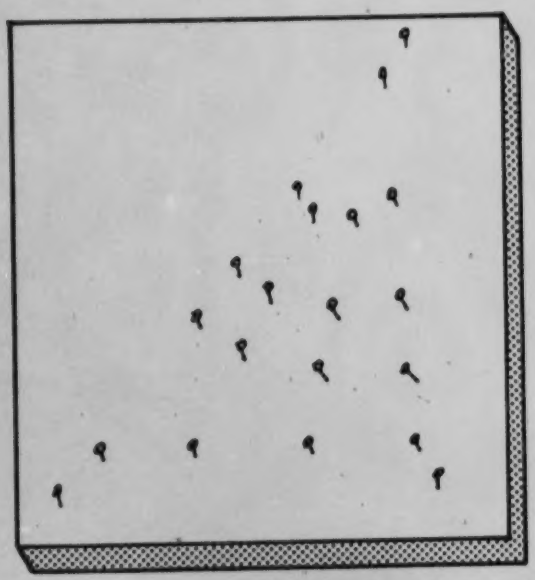
Web Weavers
Technique Card, Side 2
WEAVING WEBS

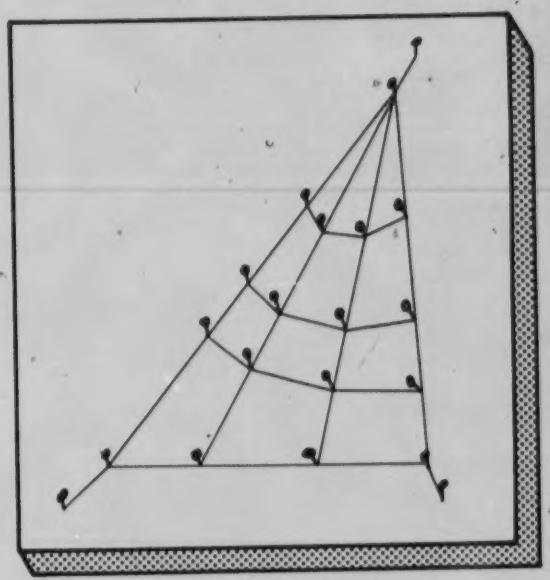
String Art Technique for Web Weaving:

String art is simple. All you need is a piece of fiberboard, nails, a thimble to push the nails into the board, and crochet thread.

1. Place a nail at each point where the web is attached to another object and at each point where two or more threads come together (intersect). The key questions will help the youngsters with this part.



2. Use the crochet thread to connect the nails. Wind the thread around each nail twice to create tension on the thread.



3. Continue to position nails and connect them with thread until the web is complete. Tie off the ends as you go.

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To Determine Your Shipping Fee:

1. **Total the weight of merchandise.**
2. **Use Table A to find your shipping zone.**
3. **If you desire surface shipment, find the shipping charge in Table B. Allow at least four weeks for delivery.**
4. **If you prefer faster (1 week or less) airmail shipment, check the box on the front of this form, and find the shipping fee in Table C.**
5. **Enter the shipping fee in the appropriate box on the front of this form.**

Table A — Shipping Zone

Zip Code Prefixes	Zone	Zip Code Prefixes	Zone	Zip Code Prefixes	Zone	Zip Code Prefixes	Zone	Zip Code Prefixes	Zone	Zip Code Prefixes	Zone
006-098	8	530-534	8	674-679	6	770-787	7	850-859	5	955	3
		535-540	7	680-681	7	788	6	860-864	4	956-959	2
100-199	8	541-543	8	683-693	6	789	7	865-880	5	960-961	3
		544-567	7			790-797	6	881-882	6	962-966	1
200-299	8	570-577	6	700-704	8	798-799	5	883	5	967-969	8
		580-582	7	705-706	7			884	6	970-974	4
300-379	8	583-588	6	707-708	8	800-826	5	890-893	4	975-976	3
380-381	7	590-591	5	710-729	7	827	6	894-897	3	977-979	4
382-385	8	592-593	6	730-739	6	828-832	5	898-899	4	980-985	5
386-387	7	594-599	5	740-745	7	833	4			986	4
388-399	8			746	6	834-835	5	900-928	4	987-992	5
		600-609	8	747	7	836-837	4	930-935	3	993	4
400-499	8	610-617	7	748	6	838	5	936-939	2	994	5
		618-619	8	749-762	7	840-844	4	940-951	1	995-997	8
500-508	7	620-667	7	763-764	6	845	5	952-953	2	998	7
510-511	6	668-672	6	765-767	7	846-847	4	954	1	999	6
512-528	7	673	7	768-769	6						

Table B — Surface Shipment

WEIGHT UP TO:		.5 Kg.	1 Kg.	2 Kg.	4 Kg.	6 Kg.	8 Kg.	10 Kg.	12 Kg.	14 Kg.
YOUR	1-3	1.50	1.50	1.50	1.75	2.00	2.25	2.50	2.75	3.00
ZONE	4-6	1.50	1.50	1.75	2.25	2.75	3.25	4.00	4.50	4.75
	7-8	1.75	2.00	2.50	3.25	4.50	5.50	6.50	7.75	8.75
WEIGHT UP TO:		**16 Kg.**	**18 Kg.**	**20 Kg.**	**22 Kg.**	**24 Kg.**	**26 Kg.**	**28 Kg.**	**30 Kg.**	
YOUR	1-3	3.25	3.50	4.00	4.25	4.50	5.00	5.50	6.00	
ZONE	4-6	5.50	6.00	6.50	7.25	7.25	8.00	8.50	8.75	
	7-8	10.00	11.00	12.00	13.00	14.00	15.00	16.50	17.25	

Table C — Air Mail Shipment

WEIGHT UP TO:		.5 Kg.	1 Kg.	2 Kg.	3 Kg.	4 Kg.	6 Kg.	8 Kg.	10 Kg.	12 Kg.
	1-3	2.25	2.50	3.25	4.00	5.00	6.50	8.00	10.25	11.00
Z	4	2.25	2.50	3.25	4.00	5.00	6.50	8.00	10.25	11.00
O	5	2.25	2.50	3.25	4.00	5.00	6.50	8.00	10.25	12.00
N	6	2.50	3.00	3.75	4.50	5.75	7.75	10.75	11.75	14.00
E	7	2.50	3.00	3.75	4.50	5.75	7.75	10.75	13.00	15.00
	8	2.75	3.25	4.25	5.25	7.25	9.00	12.00	14.25	17.00
WEIGHT UP TO:		**14 Kg.**	**16 Kg.**	**18 Kg.**	**20 Kg.**	**22 Kg.**	**24 Kg.**	**26 Kg.**	**28 Kg.**	**30 Kg.**
	1-3	13.25	15.25	17.00	19.00	21.00	21.00	25.00	27.00	29.00
Z	4	13.25	15.25	17.00	19.00	21.00	22.00	27.00	27.00	29.00
O	5	13.25	15.25	19.00	20.00	22.00	24.00	29.00	30.00	31.00
N	6	16.00	19.00	22.00	22.00	25.00	27.00	30.00	32.00	34.00
E	7	16.00	20.00	24.00	25.00	28.00	30.00	33.00	35.00	38.00
	8	20.00	22.00	26.00	27.00	31.00	33.00	37.00	43.00	44.00

June 1977 OBIS Equipment Order Form

Shipping Address (Please print):

Name: _____ **Date:** _____

Address: _____

City: _____ **State:** _____ **Zip:** _____

Please send me the following items in the quantities indicated:

QUANTITY	ITEM — DESCRIPTION		UNIT SHIPPING WT. (Kg.)	TOTAL WT. (Kg.)	UNIT PRICE	TOTAL PRICE
	Blacklight bulb for safari lamp	each	.05		$8.97	
	Blacklight fluorescent tracing powder	20 gr. pkg.	.10		.95	
	Blueprint paper (22 cm x 30 cm sheet)	25 sh. pkg.	.20		1.75	
	Bug box	each	.01		.35	
	Colbat chloride crystals	110 gr. pkg.	.15		3.75	
	Colbalt chloride test paper (1 cm x 15 m roll)	each	.025		3.00	
	Colored cellophane (25 cm x 30 cm sheet)	red, each	.025		1.00	
		green, each	.025		1.00	
		blue, each	.025		1.00	
	Confectioners dye (10 grams in vial)	each	.020		1.00	
	Kodak Studio Proof F paper (20 cm x 25 cm sheet)	10 sh. pkg.	.15		2.40	
	Line level	each	.025		1.40	
	Litter Critter Wheels thermofax transparencies	1 set of 4 wheels	.050		.35	
	Magnifying lens (3 lenses: 3x, 5x, 8x, plastic frame)	each	.025		1.00	
	Meter tape	each	.025		.50	
	Ozalid paper (21.5 cm x 28 cm sheet)	25 sh. pkg.	.15		1.00	
	Plastic measuring cup (250 ml)	each	.020		.30	
	Plastic vials with lid (14 dram)	pkg. of 10	.150		1.30	
	Spring scale (2000 gram)	each	.070		3.00	
	Thermometer, calibrated in °C	each	.025		1.25	
	Tweezers	each	.10		.40	
	Water Breathers dropper	each	.010		.20	
	OBIS Lawn Guide	each	.05		.60	
	OBIS Pond Guide	each	.05		.60	
	OBIS Trial Edition, Set I	each	1.20		8.50	
	OBIS Trial Edition, Set II	each	1.20		9.50	
	OBIS Trial Edition, Set III	each	1.20		10.50	
	The OBIS Trail Module	each	.05		2.00	

Subtotal Wt. (Kg.) **Subtotal**	
California sales tax for California residents only: (6% California residents) (6½% Bart County residents)	
Shipping fee (see reverse)	
TOTAL DUE	

☐ Check or money order enclosed.
Make check payable to:
Regents of the University of California

☐ Please bill me. (Minimum order: $10.00)

SEND YOUR ORDER TO: Discovery Corner — OBIS
Lawrence Hall of Science
University of California
Berkeley, California 94720

☐ Please check here if you desire air mail shipment.
OTHERWISE ALLOW FOUR WEEKS FOR DELIVERY.
(Air mail takes approximately one week.)

PLEASE RECHECK YOUR COMPUTATIONS AND BE SURE THAT THE SHIPPING FEE IS CORRECT.

Rec'd on _____ By _____ Shipped on 37 _____ By _____

36

ANTS
Action Card

Ants Sometimes Get Lost

"Lose" an ant by letting it crawl onto a leaf and setting the leaf down close to, but not right on, the trail. What does the ant do?

Place an ant from one trail or colony onto another trail or colony.

No materials needed.

Outdoor
Biology
Instructional
Strategies

Lawrence Hall
of Science
University of California
Berkeley, California
94720

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CHALLENGE: SEARCH FOR SIGNS OF LIFE ON A SANDY BEACH.

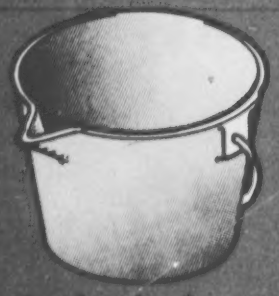
- large (baseball size) lump of clay (for Clay Impressions), *OR*
- paper and crayons (for Crayon Rubbings)

Optional
- shovels
- hand nets

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

MATERIALS

For each buddy team:
1 container (dishpan, bucket, or cut-off milk carton



1 magnifying lens* or bug box*

For the group:
1 "Aquatic Observation Aids" Equipment Card
2 flags to mark boundaries

PREPARATION

Site Selection. Any sandy beach that is littered with evidence of life is suitable for this activity. Sandy shores of lakes and bays are also good sites.

Before You Start. There are a couple of basic considerations that we hope you will discuss with your group before you turn them loose to investigate the activity site.

1. **Buddy System.** Use the buddy system as a safety precaution. (See the **SAFETY** section in the *Leader's Survival Kit.*) OBIS does not suggest going into the water, but waves and slippery rocks dictate that safety still be a prime consideration.

2. **Bring 'em Back Alive.** Check with your area's local fish and game representative or naturalist to determine if there is a moratorium on collecting organisms and shells. All organisms collected for observation should be *returned to the place where they were collected.* Rather than removing them, a

crayon rubbing or a clay impression (easier method for working with wet organisms) can be made of firm organisms, i.e. mussels, barnacles, or kelp, that are attached to a hard surface.

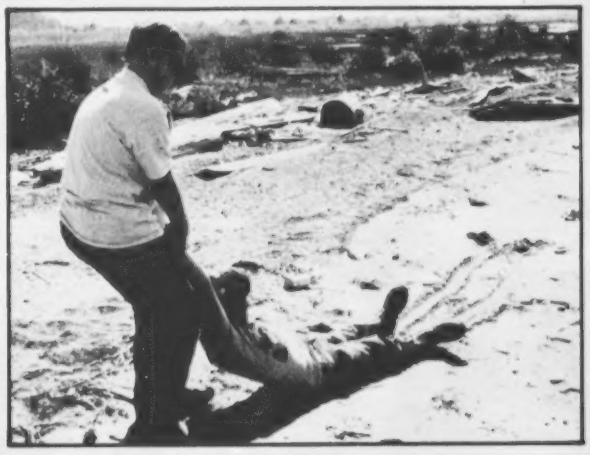
a. **Clay Impressions.** To make a clay impression of an organism, work the clay until it is pliable and flatten it into a fat pancake. Wet the organism to keep the clay from sticking to it, then gently press the flattened clay onto the organism and carefully remove the clay to obtain the organism's impression.

b. **Crayon Rubbings.** To make a crayon rubbing, simply place a piece of paper over the attached organism and, while holding the paper in place, rub a crayon over the paper to obtain an outline of the organism. (Crayon rubbings may not be too successful with wet organisms; the paper probably will shred.)

ACTION

Beachcombing for Signs of Life

1. At the beach tell the youngsters they will "comb" the beach for signs of life.
2. Mark the activity-site boundaries with flags – 50 to 75 meters of the beach should be ample. Divide the group into buddy teams.
3. Distribute containers and explain the techniques for making clay impressions and crayon rubbings. Demonstrate the use of any optional equipment that you have available (such as shovels and nets) and hand it out.
4. Tell the teams you will call them back after twenty minutes of beachcombing (actual time up to you).
5. Ask the teams to bring back one example of each sign of life that they discover.



6. Search for signs of life with the kids.
7. Call the teams back after they have combed the area and let them share their discoveries.

Beachcombing for Living Organisms

1. Introduce the difference between living organisms and the evidence they leave by asking the group if a shell is an organism. How about feathers and bones?
2. Point to the group's evidence of marine life and challenge the group to locate living organisms that might leave such evidence.
3. When the teams have finished combing the area, call everyone back to share their discoveries.
4. Encourage the kids to match up the signs of life they found with any living organisms they discovered.

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Lawrence Hall of Science
University of California
Berkeley, California
94720

Outdoor Biology Instructional Strategies

Counting It Out

Your group probably found very few organisms that could have produced the signs of life in your site. Call attention to the evidence of marine life that couldn't be matched with a living representative from the site. Ask the group to speculate where such evidence (perhaps a shell or a feather) came from and how it happened to reach their beach. The fact that there is evidence of marine organisms in your site, but that very few or none live there should lead to the speculation that the movements of the sea brought the evidence from some other site. (*Seas in Motion*, Set II, provides the opportunity to discover if oceanic motions could have carried the evidence of marine organisms to your site.)

Story-Telling Contest

Ask each team to choose one piece of evidence and make up a story about it that explains what it is, how it lived or was used, where it came from, and how it might have gotten there. To make the contest more interesting, you may wish to award a prize to the team that comes up with the story that the group enjoys the most.

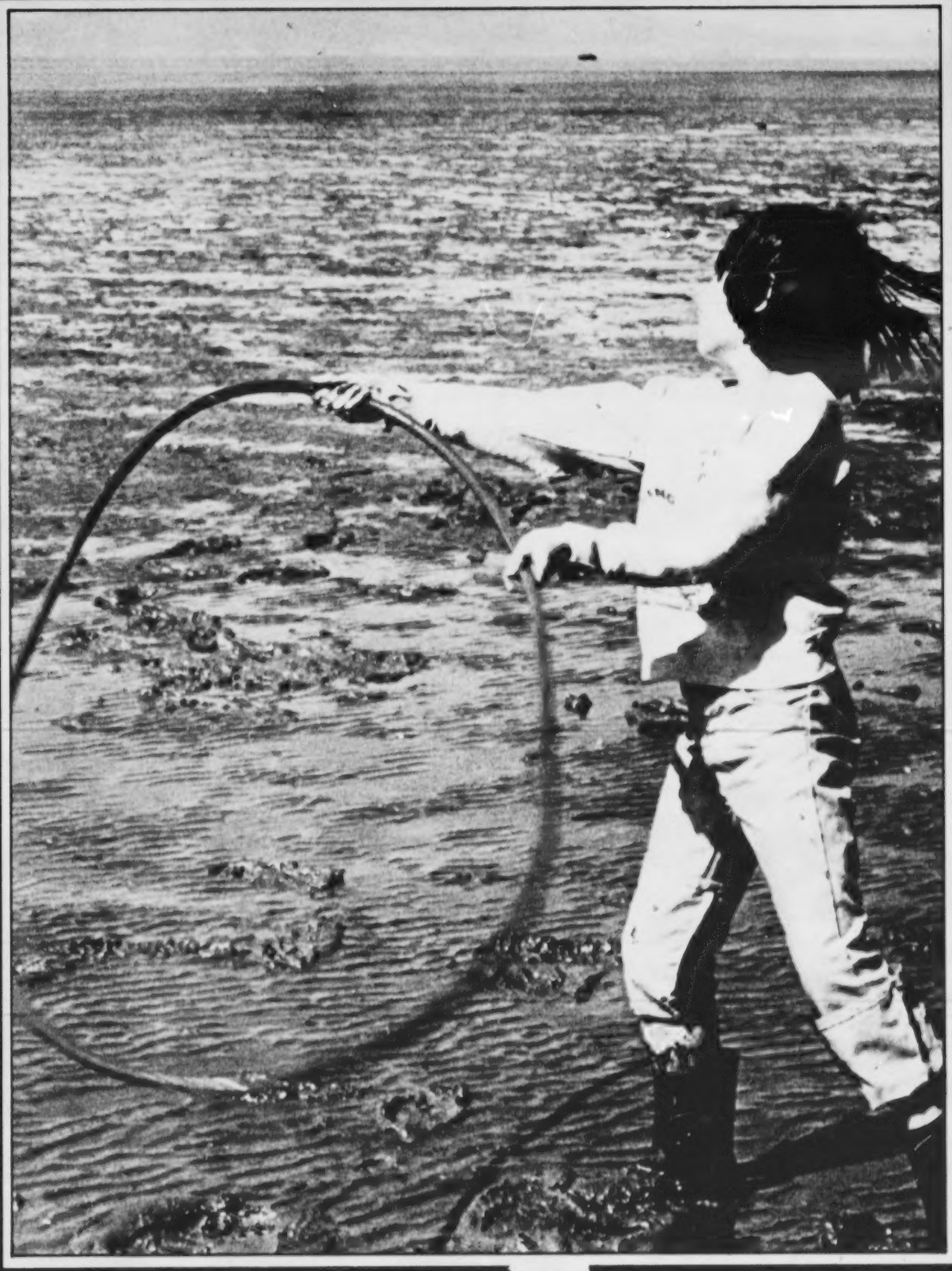
Returning the organisms. At the end of the activity, return the organisms and shells (if necessary) to the places where they were found.

FOLLOW THROUGH

Conduct an organism search on a nearby rocky shore (if available) to discover if some of the organisms that live there match any of the evidence that your group found. (*See What Lives Here?*, Set I, and *Flocking to Food*, Set II.) The search will be more interesting if it is conducted during low tide.

WHAT TO DO NEXT

Clam Hooping Set III
Hold It Set III
Night Shine Set I
Hopper Circus Set II
Seas in Motion Set II



Clams and other burrowing animals usually abound in the sand and mud flats of bays and estuaries. Yet clams leave few clues to their underground presence; often only their siphon tubes reach the surface. These tubes pump steady streams of water in and out of the clams, bringing in oxygen and food, and carrying away the clam's wastes and occasionally its reproductive products. When alarmed, a clam may retract its siphon so rapidly that a jet of water shoots out. These jets can reveal the locations and numbers of clams in an area.

Driven by thoughts of clam chowder or steamed clams, hordes of clam diggers often descend on clam beaches during daytime low tides. In many areas size and catch regulations have been established to protect clam beds from overharvest by clam diggers.

In deciding which organisms need protection and how much protection they need, Fish and Game biologists must figure out how many of the organisms currently exist. A **population census** is one means of determining the number of organisms of one kind in a given area. A **population** is a group of organisms of the same kind that lives and reproduces in a particular area.

This folio contains two one-hour activities. You can conduct each activity independent of the other or combine them into a two-part series. Both activities are designed for coastal areas containing clams. *Clam Hooping* (the first activity) requires clams that squirt. The youngsters use giant hoops to take a population census of squirting clams. From the results of this census, the group considers the task of setting up Fish and Game regulations. The second activity, *Clam Digging*, explores the natural history of clams. (This activity does not require squirting clams.)

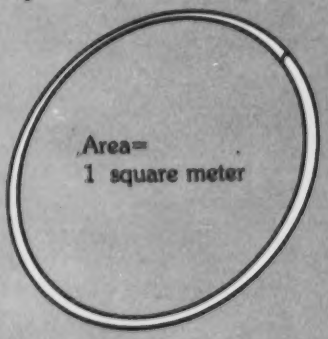
CLAM HOOPING

CHALLENGE: ESTIMATE THE NUMBER OF SQUIRTING CLAMS ON A BEACH OR MUD FLAT.

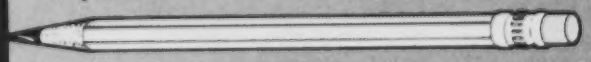
MATERIALS

Census materials for each buddy team:

1 Clam Hoop



1 Census Card
1 5" x 8" index card
1 pencil



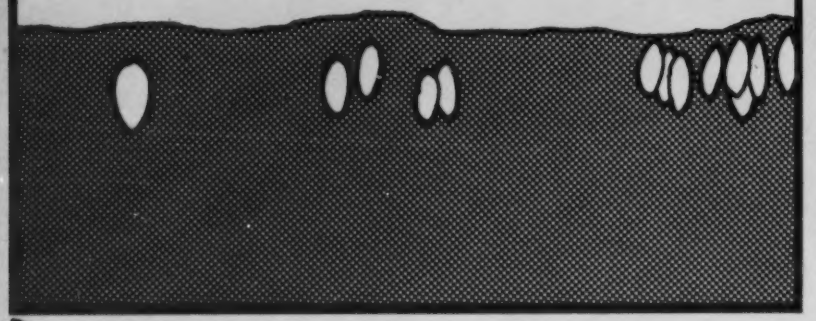
For the group:

1 "Clam Hoop" Equipment Card
1 "Using the Tide Table" Equipment Card
1 master for "Census Card"
1 data board and marking pen
4 boundary markers (flags)
1 meter tape or meter stick
1 Tide Table*
1 copy of local Fish and Game Regulations*

*Available at local fishing shops.

CLAM HOOPING
Action Card

Are clams usually found alone, in pairs, or in groups?



CLAM HOOPING
Action Card

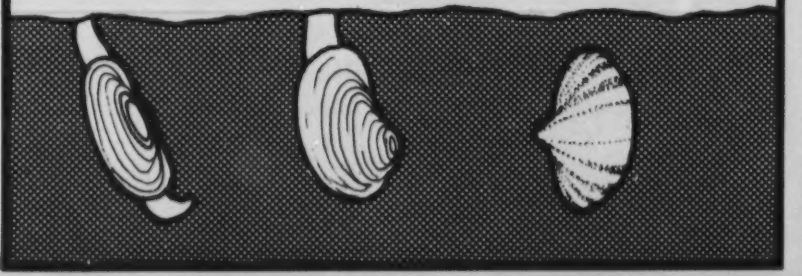
Can you find any clam shells on the beach that are different from the clams that were dug up?

CLAM HOOPING
Action Card

Is it possible to sneak up on a clam without alarming it? If so, how?

CLAM HOOPING
Action Card

How many different kinds of *live* clams can you find in the activity site?



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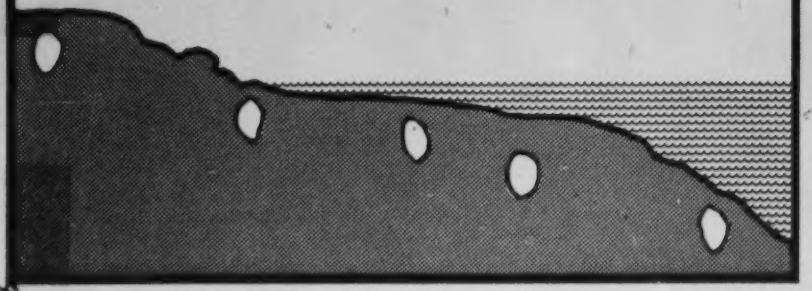
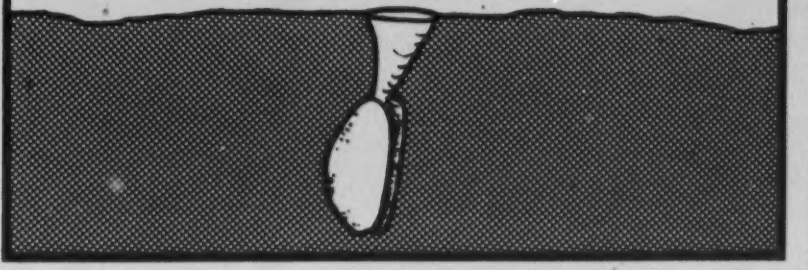
CLAM HOOPING
Action Card

How high up the beach do clams live?



CLAM HOOPING
Action Card

Is there any connection between the size of the siphon hole and the size of the clam? Could a clam digger pick out the largest clams by their siphon holes?



CLAM HOOPING
Action Card

Do large clams live deeper than small clams?

CLAM HOOPING
Action Card

What other burrowing animals live in your activity site?

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Clam Hooping
CENSUS CARD

HOOP COUNTS	NUMBER OF CLAMS
1	
2	
3	
4	
5	
6	

Total number of hoop counts = _____ **Total number of clams =** _____

AREA

To find the **area** of the activity site, multiply the **length** of the site by the **width** of the site.

_____ **length** in meters

x _____ **width** in meters

= _____ square meters

(**Length** x **width** = **area** in square meters.)

CENSUS

To find the **average number of clams** per square meter, divide the **total number of clams** by the **total number of hoop counts.**

(Total # of hoop counts) _____) _____ (Total # of clams)

(# of clams per _____ square meter)

(Total number of clams ÷ Total number of hoop counts = average number of clams per square meter.)

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CLAM DIGGING

CHALLENGE: EXPLORE THE NATURAL HISTORY OF CLAMS.

Biologists consider many factors besides a population census before deciding if a particular organism needs protection. Other questions considered include: How many clams are currently being removed or injured by clam diggers? How much of the clam bed is exposed by the tides and available for investigation? In this part of the activity your group investigates natural features of clams that help biologists develop management practices.

MATERIALS

For each buddy team:
1 shovel or trowel
1 bottomless bucket (five-gallon plastic bucket with bottom removed) for clams that live deeper than 30 centimeters
1 meter stick or tape

For each participant:
1 pair of leather, cotton, or rubber gloves and enough masking tape to seal the glove cuffs

For the group:
2 sheets of Action Cards
1 data board and marker

PREPARATION

Action Cards. Tape or write the Action Cards on the data board.

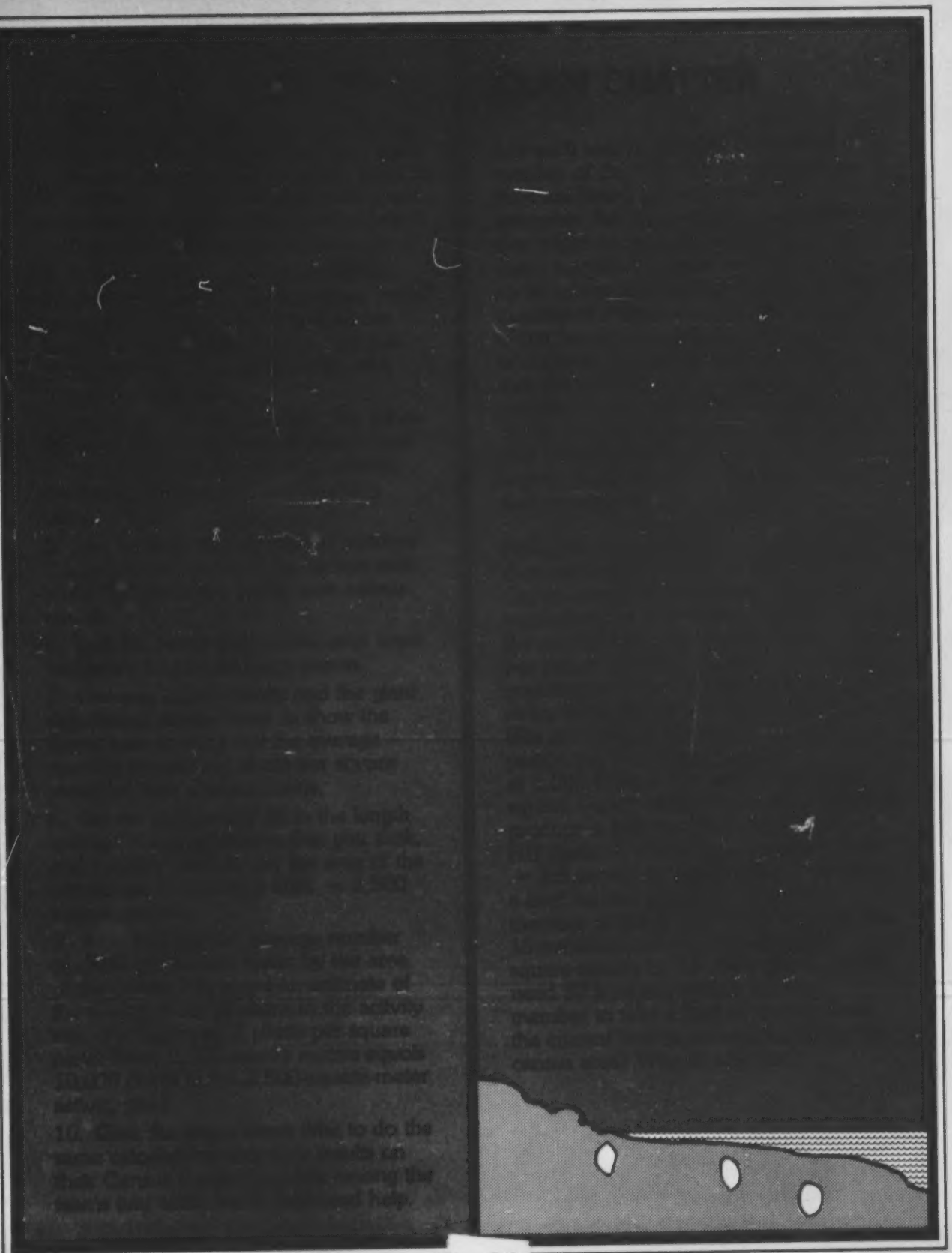
Clothes, Safety, Site. See the **PREPARATION** section in the first part of this activity.

Digging procedure. See the **ACTION** section. It's a good idea to visit the activity site and try out the digging procedures beforehand.

Digging safety. Caution the youngsters to wear gloves to protect their hands from broken shells, glass, and other sharp objects buried in the mud or sand. Taping the gloves at the cuffs prevents them from filling up with sand or mud.

ACTION

1. Divide the group into buddy teams of two to three kids. Point out the boundaries of the activity site.
2. If you haven't already done *Clam Hooping* on this site, announce that clams live here. Ask the teams to predict how deep the clams live beneath the surface of the beach.
3. If you are working in an area where clams live deep beneath the surface, demonstrate the bottomless-bucket procedure outlined below.
   a. Jump on the ground near some siphon holes to give the clams a chance to draw in their siphons before you start digging.
   b. Use the siphon holes as a center point and carefully (to avoid breaking the shells) start digging around the siphon holes.



about 100 square meters (10m × 10m) in which to work.

Fish and Game regulations. Before the activity, look up the current regulations on personal bag limit per day and clam season dates (if you plan to take any clams with you).

Safety. For general safety procedures to use around aquatic sites, see the **SAFETY** section in the *Leader's Survival Kit* folio. Ask the kids to walk with caution on mud flats to avoid falling.

ACTION

1. Ask the group to walk outside of the census area while you flag the boundaries. (This will minimize the disturbance to the clams.) Gather the youngsters in a group about twenty meters away from the census area. Divide the group into buddy teams of two or three.
2. Grab a Clam Hoop and a Census Card. Tell the youngsters that they are going to estimate the number of clams living in the marked-off area. Explain that when clams are disturbed, they clam suck in their siphons so quickly that water in the tube squirts out in a jet. Describe the Clam-Hoop census technique outlined below.
   a. The teams spread out along the edge of the census area — at least 10 meters apart.
   b. To select a small area in which to count clams (a quadrat), one of the team members closes his eyes and tosses the Clam Hoop into the census area.
   c. All of the team members run over to the hoop and jump up and down around the outside of the hoop. Watching for water jets will help them locate the siphon holes. The

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c. When the walls of the hole start caving in, place the bottomless bucket in the hole and shove it in until the rim sticks a few centimeters above the surface. Make sure that the sides of the bucket are not too close to the siphon holes.

d. Never dig with your hands; the bottomless bucket will keep the hole from caving in.

e. When you feel a clam, loosen it by digging out the sand or mud around it, and then carefully lift it out. Use meter tapes or sticks to measure how far beneath the surface the clam was found.

f. You won't need a bucket for clams that stay close to the surface. Just dig with your hands or a shovel.

4. Ask the teams to dig and remove clams carefully so as not to damage the clams' shells. Warn the group that pulling up a clam by its siphon tube often results in tearing off the siphon tube. Also mention that most clams will die if left uncovered on a beach. At the end of the activity, each team should rebury the clams in the holes from which they were taken.

5. Hand out the equipment, and challenge the teams to find out how deep beneath the surface clams live.

6. After the teams have uncovered a few clams, display the Action Cards on the data board. Let each team choose an Action Card to investigate. More than one team may work on the same challenge. When a team finishes one challenge, let the team members select another challenge.

7. Near the end of the activity call the teams together for discussion.

CLAM CHATTER

Ask each team to report what they discovered when they explored their Action Card challenge.

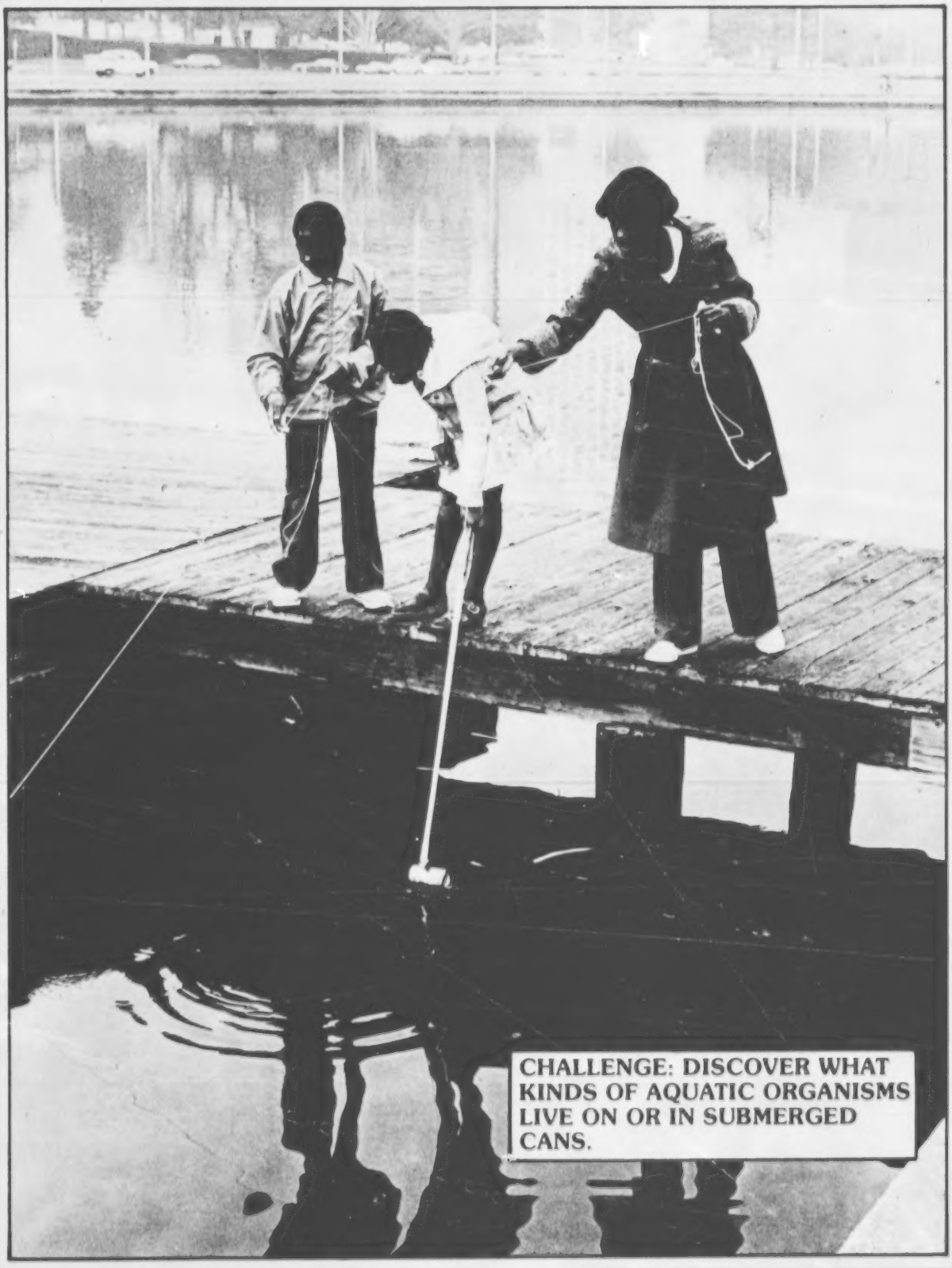
BEFORE LEAVING THE AREA, MAKE SURE THAT NO CLAMS HAVE BEEN LEFT UNCOVERED.

FOLLOW THROUGH

If you did only one of the two activities in this folio, do the second as a follow-through activity.

WHAT TO DO NEXT

Beachcombing	Set III
Can Fishing	Set III
Night Shine	Set III
Bean Bugs	Set I
Beach Zonation	Set II
Flocking to Food	Set II
Water Breathers	Set II



CHALLENGE: DISCOVER WHAT KINDS OF AQUATIC ORGANISMS LIVE ON OR IN SUBMERGED CANS.

"Don't be a litterbug!" Despite a national campaign against littering and some impressive fines to discourage litterbugs, many people continue to litter. Part of the problem can be traced to the fact that almost everything we buy comes in a disposable package.

Aquatic recreation areas are often particularly hard hit by litterbugs. Not only are the shores usually strewn with litter left by leisure seekers, but lake and reservoir bottoms are frequently sprinkled with beer and soda pop cans and bottles as well. Interestingly enough, discarded cans and bottles often become underwater homes for a variety of aquatic organisms, such as minnows, crayfish, snails, scuds, and small catfish. Most animals are particularly vulnerable to predation during their early development. The narrow openings of cans and bottles can exclude potential predators and improve a young animal's chances of survival.

This activity invites your group to go *can fishing* and discover if any aquatic organisms live on or in submerged cans. The concept of **habitat** is introduced at the end of the activity.

You can retrieve submerged cans in a variety of ways: picking them up by hand, using a long-handled net, a magnet on a line, or an OBIS Can Grabber. (See the "Can Grabber" and "Sweepnet" equipment cards in the *OBIS Toolbox* folio.) *Can Fishing* can be done from shore, a dock, or even a boat. If you plan to *can fish* from boats, you should have at least one experienced boat handler and strong swimmer in each boat. If you are a certified diver and each group member is a strong swimmer who has been trained in the use of mask and snorkel, you may want to snorkel for cans in clear water.

MATERIALS

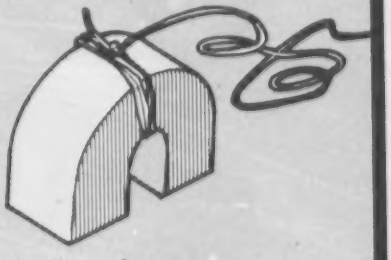
For each buddy team:

1 pair of cotton work gloves or two old socks (for safely handling cans)

- several gallon or half-gallon milk cartons or light-colored basins for holding cans and contents (Buckets will be needed if the *can fishing* is good.)

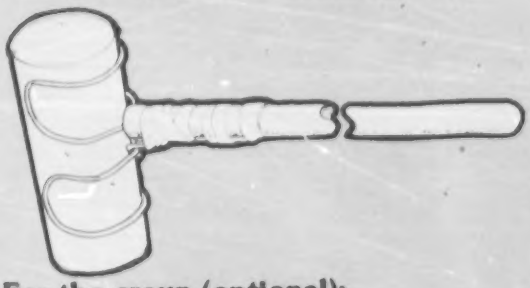
Fishing from shore:

1 strong magnet tied to 5 to 10 meters of heavy twine or fishing line



Fishing from dock or boat:

1 of the following: magnet and string, long-handled net, or Can Grabber



For the group (optional):

- bug boxes* or hand lenses*

1 OBIS *Pond Guide**

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

CAN FISHING

PREPARATION

Safety. For safety reasons, OBIS suggests using the buddy system at aquatic sites. (See the *Leader's Survival Kit* folio.) Follow boating safety procedures if you fish from a boat. The youngsters should wear gloves when handling cans.

Site. Choose a lake, pond, reservoir, or bay site that contains a good number of submerged cans. This activity is not suitable for fast running streams and rivers. Working at a site with clear water will increase your *can fishing* success because the participants will be able to spot submerged cans from the surface. At dirty-water sites check the availability of submerged cans by using a magnet on a string to scout around under water. Avoid sites that are posted with signs warning of unsafe or contaminated water. If more than one site is available, choose the site with the greatest number of submerged cans. If necessary, obtain permission to use the site.

Equipment. The magnet on a string does not work on all cans. To retrieve aluminum cans you will need a Can Grabber or a sweepnet. The grabber and the net can only be used effectively, however, when submerged cans are visible from the surface.

Take 'em Back Alive!

Pour the contents of each retrieved *can* into a container with water. Place the empty cans in a container of water in case you miss any organisms that are attached to the *can*. Keep *can organisms* moist and sheltered from direct sunlight. After everyone has had a chance to see what *can organisms* were found, return the organisms to the aquatic site. (The youngsters will decide after the investigation whether they will return the cans.)

ACTION

1. Divide the group into teams of two and introduce the buddy system.
2. Point out the physical boundaries of the site. It should be large enough for everyone to investigate without interference, yet small enough to allow easy supervision of the group.
3. Challenge the teams to catch as many cans as possible, and to discover what kinds of aquatic organisms live on or in submerged cans. The contents of each captured *can* should be poured into a container. The empty cans should be placed in water and retained for the end of the activity.
4. Explain and demonstrate the *can-fishing* method your group is going to use.
5. Hand out the *can-fishing* gear and let the teams begin.

6. While keeping an eye on all of the teams, join in the *can fishing* yourself.
7. When about fifteen minutes remain in your activity period, call all of the teams together and let them share their *can catches*.

Trial Edition
Set III

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CANDID THOUGHTS

1. What kinds of aquatic organisms did you find living in or on cans?
2. Did some cans have no organisms? Why might that be?
3. What advantages might a *can* offer as a home for certain organisms? What disadvantages?
4. Introduce the concept of **habitat** by telling the kids that the place where an organism lives is called its **habitat.**
5. Ask the youngsters to think of ways in which people reduce available plant and animal habitats, e.g. clear-cutting of forests, filling in bays or marshes, turning open space into new buildings or roads, and polluting. Ask the group to give examples of how people might improve or increase plant and animal habitats, e.g. building artificial reefs, cleaning up pollution, and letting certain areas revert back to their original state.

LITTER OR HABITAT?

Tell the kids that they have a problem to solve. Now that they have discovered that certain organisms use submerged cans as homes, should they dispose of the cans as litter, or return the cans to the water because they house aquatic organisms? A good question to start the discussion is: "If the cans were removed, where might the organisms live?" Your best bet is to have the teams search for organisms living in or on natural materials before making a decision. (See the **FOLLOW-THROUGH** section.) Let the kids make the final decision between themselves, and go along with that decision.

FOLLOW THROUGH

Search for organisms that live on or in natural materials (not man-made). Do any of the *can organisms* also live on or in natural materials?

WHAT TO DO NEXT

Hold It	Set III
Junk-in-the-Box	Set III
Animal Movement in Water	Set I
Litter Critters	Set II
OBIS Oil Spill	Set II
Too Many Mosquitoes	Set II

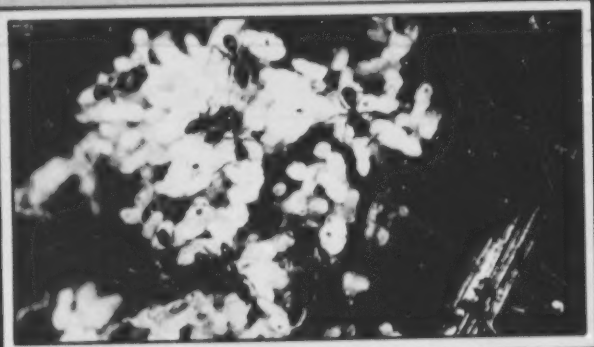
CHALLENGE: FIND OUT
HOW ANTS RESPOND TO
DIFFERENT SITUATIONS.

Ants, ants, ants! When they invade a kitchen, picnic area, or other territory that humans think is theirs, trouble is near. We think of any invasion of ants as a personal insult, yet they are only trying to make a living. Some variety of ant is found in nearly every part of the world.

Ants are colonial insects living together and cooperating in nearly all aspects of their lives. They communicate directly by touching various segments of their antennae together, and indirectly by releasing chemicals onto the surfaces on which they walk. The effectiveness of communication between ants is responsible for those long and busy ant trails you see so often.

Food and water are of prime importance to ants, just as they are for other animals. You have probably seen ants carrying pieces of food to their nests. Ants eat such diverse foods as peanut butter, fruits, and other insects.

In dry areas of the country ants may burrow deep into the ground for moisture but may be seen scurrying about with



their eggs whenever their nest becomes wet. Ants, like most animals, must make living adjustments several times a year to remain in an acceptable environment. Inadequate food or water, or excess water, may cause them to enter human homes where they can often find both food and water or escape flooded soil.

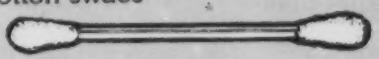
In this activity, instead of screaming "Ants! Ants!" the children investigate the behavior of ants and discover what kinds of food excite and attract ants, how ants respond to water, if "lost" ants can find their trail again, and where nests are located.

MATERIALS

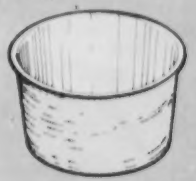
The materials listed include everything necessary for a group of eight. Add extra materials for larger groups.

For the group:

30 cotton swabs

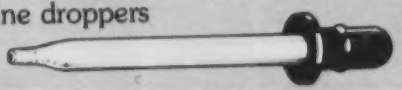


1 to 2 liters of water
1 sprinkler can or bottle (as used for ironing)
12 small paper cups
12 popsicle sticks



- paper or transparent tape

2 medicine droppers



- assorted possible ant foods (peanut butter, sugar, ice cream, cereal, nuts, flour, crackers, soda pop, popsicles, honey)

3 pieces of cardboard (to create wind by waving)
5 soda straws
1 master each of three sheets of Action Cards
1 duplicated Action Card for each youngster or team of two (plus a few extra)

ANTS
Action Card

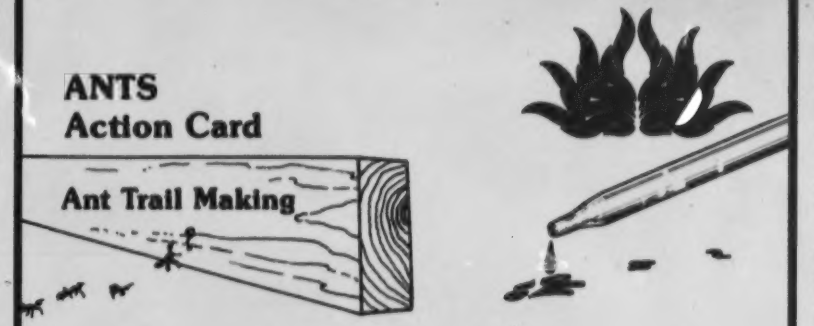
Fanned Ants

Create a wind on an ant trail to determine what they do.

Materials: piece of cardboard to wave, or soda straw to blow through.

ANTS
Action Card

Ant Trail Making

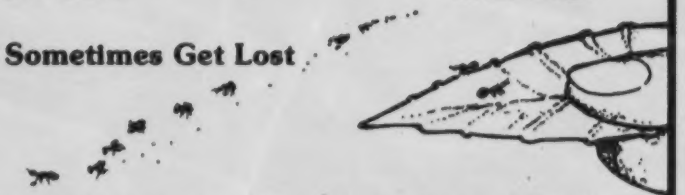


Which is the best way of changing an ant trail?
1. By providing rewards such as laying down a new trail of food?
OR
2. By blocking the old trail with some object? (Rocks, sticks)

Materials: Super food, rocks, soil, sticks, rope, cans.

ANTS
Action Card

Ants Sometimes Get Lost



"Lose" an ant by letting it crawl onto a leaf and setting the leaf down close to, but not right on, the trail. What does the ant do?

Place an ant from one trail or colony onto another trail or colony.

No materials needed.

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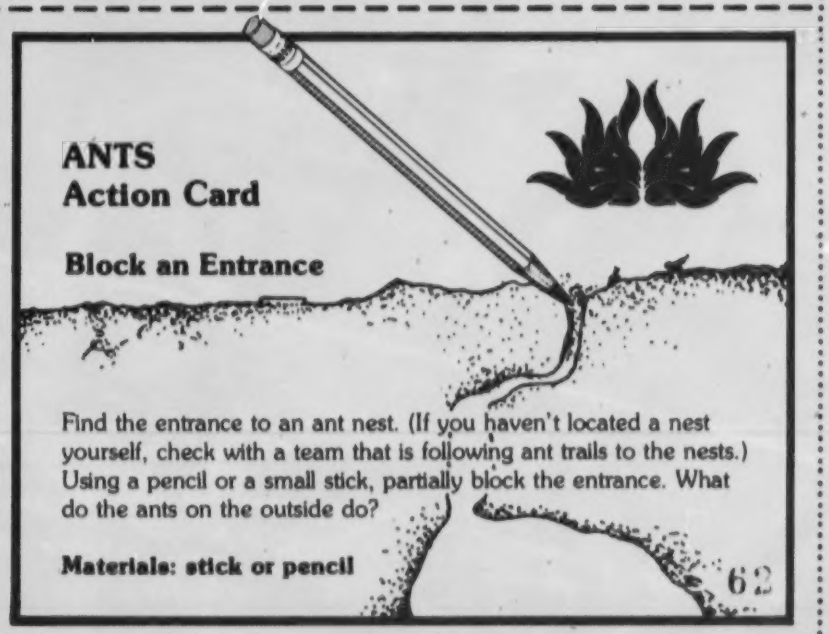
ANTS
Action Card

Block an Entrance



Find the entrance to an ant nest. (If you haven't located a nest yourself, check with a team that is following ant trails to the nests.) Using a pencil or a small stick, partially block the entrance. What do the ants on the outside do?

Materials: stick or pencil

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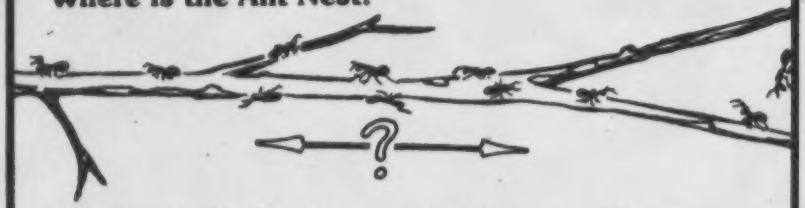
ANTS
Action Card

Where is the Ant Nest?



Find an ant trail and see if you can find out from watching the ants which way their home is. Then follow the trail to the ant nest.

No materials needed.

ANTS
Action Card

Ant Flood

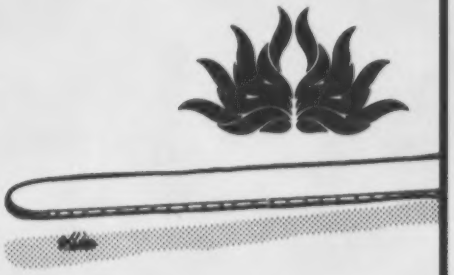
Slowly drop one to twenty drops of water on an active ant trail to find out what the ants do.

Use a sprinkler to fake a rain storm on an ant trail. What do the ants do? How long before life is normal again?

Materials: water, medicine dropper, water sprinkler.

ANTS
Action Card

Dead Ants



Find a dead ant and use a popsicle stick to squash it on the ant trail. What happens?

Find a different kind of tiny dead animal and squash it on a different part of the ant trail. What do the ants do?

Materials: popsicle stick, dead ant, or other animals

ANTS
Action Card

Ant Trails

Do ants take shortcuts? Why do you suppose they take the paths they do?

No materials needed.

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PREPARATION

Time of year. You will find more ants above ground during warm weather.

Group size. This activity works best with small groups of four to eight children.

Site. Find an area that has ants, preferably lots of ants and ant trails. Look along building edges, outdoor walks, paths, and straight boards. You will be most successful with this activity if you work with the common house ants that

typically invade kitchens, picnic areas, and other places where human food is available. You will not have as much success with the larger carpenter or red ants.

Foodstuffs. All the foodstuffs you or the kids bring will get dirty, so don't bring a full jar of anything. Instead, place an amount equal to about two tablespoons into paper cups or sandwich bags. Bring extra sugar or sweet substances such as jam, jelly, or sweet soda pop.

ACTION

Introduce the activity by calling the kids over to an active ant trail and asking them what they know about ants. After listening to their ideas, suggest that they experiment with ants and find out how the ants respond to water, different foods, disturbances, and other situations.

1. In full view of the youngsters prepare a flour solution in a cup by adding one-half teaspoonful of flour to about ten teaspoonfuls of water. Emphasize that only a *small* amount of food or bait should be offered to the ants.
2. Stir the solution with a cotton swab, and dab a little *next* to an ant trail.

3. Observe the responses of the ants for a minute. (They may appear to investigate the solution, but probably will not eat it, and may avoid it altogether.)
4. Express your disappointment at the failure of the ants to eat your flour solution. Ask the kids for some suggestions on foods ants will eat, or on how you could change the solution to make it more appealing to the ants.

Discovering Super Food

1. Suggest to the youngsters that they use the foods you brought to find one that is a "super" food for these ants.

Trial Edition
Set III

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2. Inform the kids that the ants may not eat some undiluted food such as jam, but may eat the jam after it has been diluted with water.

3. Point out the boundaries of the study site, and tell the kids to use *tiny* amounts of food. Divide the group into teams of two and begin.

4. Encourage the kids to share their super-food findings with the others.

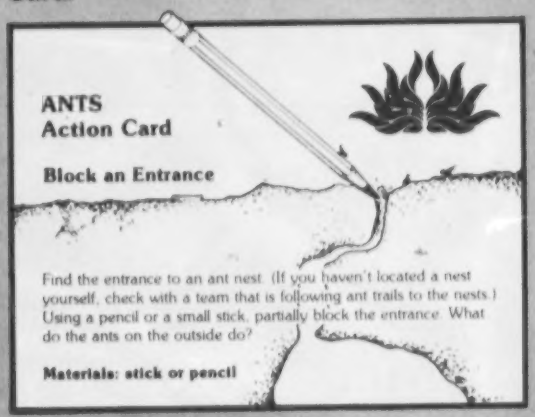
Discover Other Ant Responses

1. After the kids have discovered a super food for the ants in your area, invite them to do some other experiments with ants.

2. Distribute one of the duplicated Action Cards to each team or youngster.

3. As the kids work on their experiments, visit each of the youngsters to see how they are doing. Encourage them to show or tell you what they have discovered. Encourage the teams to try other ideas they may have that are not on any of the Action Cards.

4. After a youngster completes an experiment, offer her another Action Card.


ANTS
Action Card
Block an Entrance
Find the entrance to an ant nest. (If you haven't located a nest yourself, check with a team that is following ant trails to the nests.) Using a pencil or a small stick, partially block the entrance. What do the ants on the outside do?
Materials: stick or pencil

5. Before you have to stop the activity, gather the kids for some idea sharing.

COMMUNICATING ABOUT ANTS

☐ After gathering the kids, ask some of them to read their Action Cards and tell the group what they discovered.

☐ What techniques could you use to keep your home free of ants without using poisons? (Providing food *outside* the house, cleaning *inside* the house, blocking entrance holes, etc.)

FURTHER ANTICS

☐ Try to get some of the ants from a colony to start a new one by providing them with lots of food at another location.

☐ Carefully carve away the opening to an ant nest *without tearing up the nest.* Are there many tunnels? Other exits? Cross tunnels?

☐ Discover what kinds of materials, e.g. wood, metals, plastic, water, or concrete, ants avoid or refuse to use as pathways.

☐ Find out how ants around their nest respond when a different kind of live ant, or an ant from a different nest, is placed there.

☐ Find out what ants do at night.

WHAT TO DO NEXT

Follow the Scent	Set III
Isopods	Set III
Junk-in-the-Box	Set III
Sticklers	Set I
A Better Fly Trap	Set II
Attract a Fish	Set II
Hopper Circus	Set II

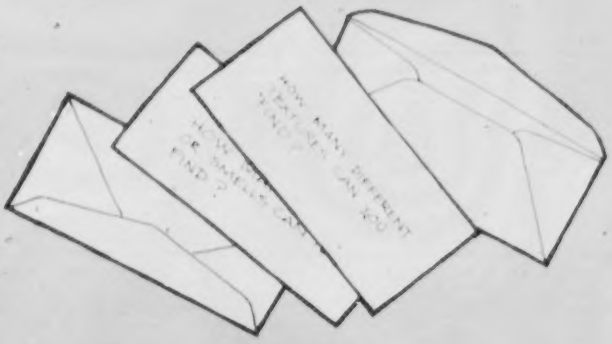
CHALLENGE: FIND EXAMPLES OF THE VARIETY IN NATURE AS SUGGESTED ON YOUR ENVIROLOPE.

Many people enjoy a walk in the woods, along the shore, or in other outdoor places. An awareness of the variety found in nature can enhance the aesthetic appreciation and value of such walks. The color of fall leaves, the fragrance, shape, and color of spring flowers, the textures and patterns of trees, ferns, and mosses are only a few examples of the variety found in the out-of-doors.

Envirolopes works well in almost any outdoor setting and in a variety of different ways: along a trail, around a science center, at a camp, or on a family outing. Teams of two or three receive a challenge such as: "Find at least five different shades of green." The participants collect samples small enough to fit in envelopes, and then display and discuss their discoveries.

This activity encourages the participants to develop the ability of making observations and sharing them with others. In addition, the activity emphasizes the variety of colors, forms, textures, and organisms present at any outdoor site. *Envirolopes* works well with mixed-age groups of participants.

MATERIALS



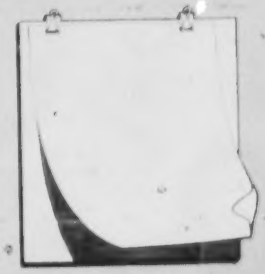
For each team of two:
1 letter-sized envelope with one challenge on it. Possible challenges include:

- ☐ Find the ten most unusual-shaped leaves.
- ☐ Find at least five different textures.
- ☐ Find examples of at least five different odors or smells.
- ☐ Find at least five different kinds of seeds.
- ☐ Find at least five objects, each one of a different color.
- ☐ Find at least five different kinds of evidence that animals are around (such as a leaf with bites taken out of it).
- ☐ Find at least five different kinds of evidence that people are around (trash, for example).
- ☐ Find at least five different kinds of rocks.
- ☐ Find at least five objects with different shades of brown.
- ☐ Find at least five objects with different shades of green.

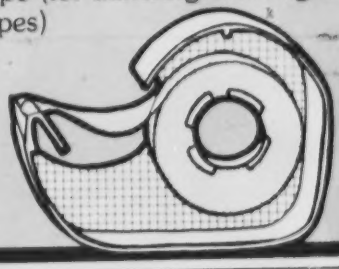
For seashore sites include:

- ☐ Find at least five different kinds of shells.
- ☐ Find at least five different colors on one shell.

For the group:
1 copy of "Envirolope Challenges" card
1 data board



1 felt pen
• glue or tape (for adhering challenges to envelopes)



Envirolopes

ENVIROLOPE CHALLENGES

Find the ten most unusual-shaped leaves.

Find at least five different textures.

Find examples of at least five different odors or smells.

Find at least five different kinds of seeds.

Find at least five objects, each one of a different color.

Find at least five different kinds of evidence that animals are around (such as a leaf with bites taken out of it).

Find at least five different kinds of evidence that people are around (trash, for example).

Find at least five different kinds of rocks.

Find at least five objects with different shades of brown.

Find at least five objects with different shades of green.

Find at least five different kinds of shells.

Find at least five different colors on one shell.

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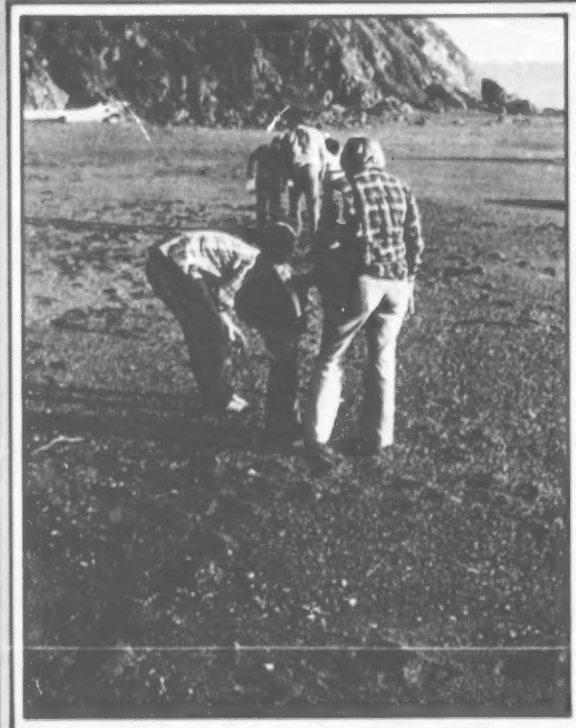
ENVIROLOPES

PREPARATION

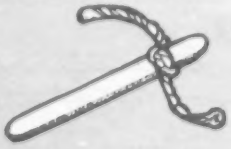
Site. Select a site where collecting small samples of leaves, rocks, and twigs or shells is not a problem. Obtain permission if necessary.



Envirolopes. Make a copy of the "Envirolope Challenges" card. Select the challenges that are appropriate for your site and group. Cut the challenges apart and adhere one to each of the envelopes.

Alternatives to collecting. If regulations or a fragile habitat preclude collecting, some alternative approaches you can take for identifying discoveries include:

1. **Flagging.** Use a different color of cloth or yarn for each team. With this method, the group will have to walk around the site to discuss the choices.



2. **Photograms.** See *Habitat Sun Prints* (Set I). Compare and discuss the prints.
3. **Crayon Rubbings.** See *Gaming in the Outdoors* (Set II). Compare and discuss the rubbings.
4. **Photography.** Compare and discuss the evidence later.

ACTION

1. Select a discussion area and point out the boundaries of the site to the group. Show your participants an example of an envirolope challenge and encourage them to discuss how the challenge might be met.
2. Divide the group into teams of two. Explain that each team will receive an envelope with a challenge on it. The teams will have twenty minutes to search for small samples. Make a rule that each team's samples must fit in the envelope.
3. Save one envirolope for yourself, and distribute the others to the group. Circulate among the teams as they search, encouraging them to investigate further. Listen to any unusual reports, and offer encouragement or assistance when necessary.
4. Call everyone back together after twenty minutes, and ask each of the teams to display their collections. Ask the teams to circulate, observing and informally discussing each other's evidence.
5. Select one or more collections that appear particularly interesting, and ask the teams to report to the group on what they collected and what their collections show. Ask the other teams to check their collections for items that could be added to the collection being shared. Continue this process for as long as the participants find it interesting.

Trial Edition
Set III

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WHAT DO YOU THINK?

1. What objects appeared in more than one collection?
2. How does the evidence of other animals compare with the evidence of people? Did you find more evidence of animals or of people? What types of evidence do animals leave? What types of evidence do people leave?
3. Which collections contained the most items? Why?
4. Which was the most difficult challenge to meet?
5. Which item, because of its variety of properties, could be included in the largest number of individual team collections?

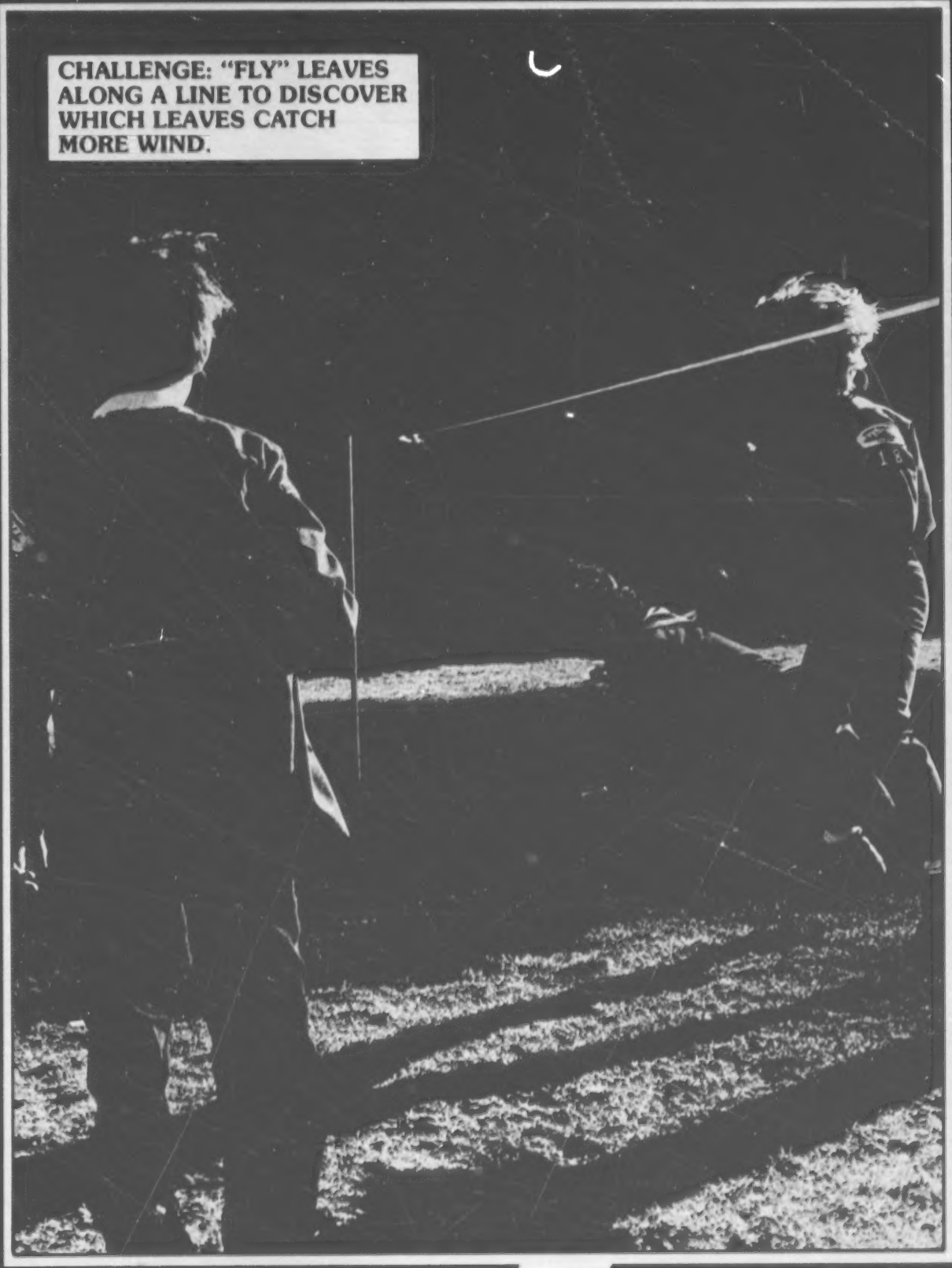
Keep discussions short. If, however, a discussion appears to wander from biology to art or some other form of creative expression, don't feel that you have to guide the discussion back "on course." Such interest is the key to developing environmental awareness, appreciation, and understanding.

FOLLOW UP

1. Repeat the activity at a different site or at a different time of year.
2. Ask interested individuals to make up new challenges for another hunt.
3. Make a collage with the samples collected.

WHAT TO DO NEXT

Pigment Puzzles	Set III
Variation Game	Set III
Who Goes There?	Set I
Plant Patterns	Set II
Sensory Hi-Lo Hunt	Set II


CHALLENGE: "FLY" LEAVES
ALONG A LINE TO DISCOVER
WHICH LEAVES CATCH
MORE WIND.

A strong wind can take all the fun out of many outdoor activities. But *Fly A Leaf* takes advantage of a windy situation. Kids will be cheering the wind instead of hiding from it. It's a breeze!

Wind exerts a force on objects in its path. Animals can usually escape this force by moving to a sheltered place, but plants cannot move to avoid the wind. The amount of wind force a plant can withstand is partly determined by the number, size, shape, and flexibility of its leaves. The more wind individual leaves catch, the greater the total force on the whole plant and the potential damage to it. Leaves are the primary food-producing structures of most plants. If leaves are not able to stand fast against the force of the wind and are blown away, the plant loses its major source of food.

Wind affects more than individual plants, however. In consistently windy areas, whole communities of plants are molded into pieces of soft, round living sculpture. Such winds also affect the micro-environment; animals and plants that cannot withstand strong winds are unable to live in such areas.

In *Fly A Leaf* youngsters investigate the interactions between wind and leaves. Teams set up "leaf lines" and race different leaves to see which ones catch the most wind. After the leaf races the youngsters briefly tour the activity area to look for evidence of wind damage (torn leaves, broken branches, bent or flattened plants). The youngsters use the evidence they find and the results of the races to discuss plant/wind interactions.

MATERIALS

For each team of two:

1 leaf line set-up (to be assembled by kids):
- 2 sticks (broomstick thickness) 1 meter or longer
- 1 plastic soda straw cut into 4 or 5 pieces
- 1 six-meter length of 40 lb. test *monofilament* nylon fishing line (braided string doesn't work)

1 small piece of cardboard
1 roll of clear tape

1 hammer, rock, or board (for driving sticks into the ground)

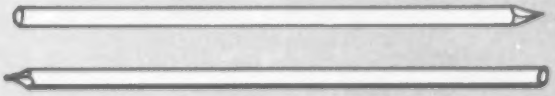
For the group:

1 watch with second hand
1 spool of thread (for "tattletails" to monitor wind direction)
1 pair of scissors

PREPARATION

1. Cut plastic soda straws (one straw for each team) into four or five pieces each.

2. You will need two sticks (broomsticks, dowels) a meter or more in length for each team. Sticks must be sharpened so they can be pushed into the earth.



3. You will need to cut some 40 lb. test monofilament fishing line into six-meter segments, one piece for each team. Wind each segment around a small piece of cardboard.

Time and Place

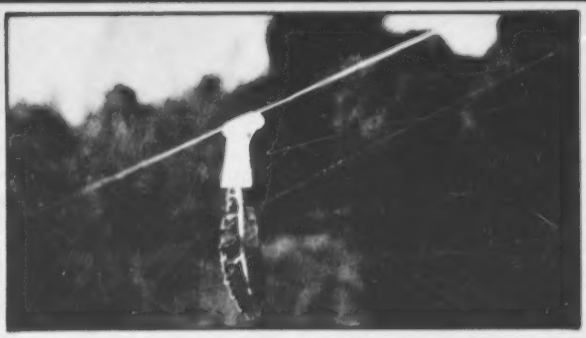
Select a large, flat lawn with trees, bushes, and grasses. And, of course, order up a stout wind!

ACTION

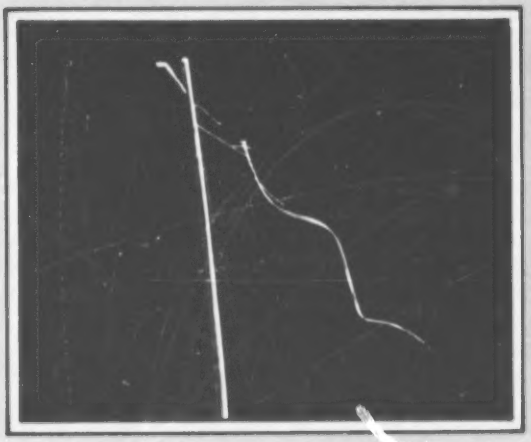
1. Focus the youngsters' attention on the wind. Tell the group that one environmental factor that plants must deal with is the wind. Ask them to notice how the wind is bringing a great deal of force to bear on the leaves of these plants.

2. State the challenge: "Let's discover which leaves catch the most wind." Show the youngsters the "leaf lines" that they will use to experiment with various leaves. Set up one as a demonstration.

Slide several straw segments onto the line. Tie the line to two sticks. Orient the leaf line so the wind is blowing along the line, and shove or hammer the sticks into the ground. Show the group how to tape leaves to the straw segments and fly them down the line.



3. Ask which way the wind is blowing. Tell the kids they will have to monitor wind direction continuously to keep the lines aligned with the wind direction. Leaf lines are easily readjusted to accommodate changes in wind direction. Some kids may want to attach a "tattletail" on one stick of their apparatus. Demonstrate.



This little device lets kids keep track of which way the wind is blowing.

4. Divide the group into teams of two. Distribute one unassembled leaf-line set-up, roll of tape, and some thread to each team. Have the teams assemble their leaf lines and then practice flying leaves of many different sizes and shapes. Circulate among the teams, encouraging them to select leaves from the surrounding plants, always searching for leaves that look like "fast fliers." Tell the kids that there will be a "fly-off" later: each team will enter its fastest leaf in a "fly-off" race. Allow twenty minutes or so for free exploration.

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5. **The Fly-Off.** Have a fly-off of fastest leaves. Set up two or three leaf lines parallel to one another. Have each team bring its fastest leaf. Time the events. Several heats may be necessary to determine winners. (The fly-off is usually quite exciting.) Ask the kids to determine which features of the leaves make them fast or slow fliers (shape, size, length, thickness).

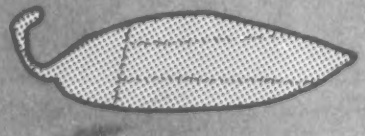
BLOWIN' IN THE WIND

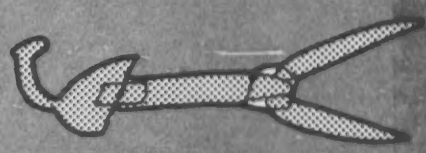
Observe your "fastest fliers" *on* their plants. Compare the actions of those leaves to the actions of leaves on other plants.

1. Do whole plants bend?
2. Do the leaves move in ways that enable them to avoid being hit by the wind's full force?
3. Is there evidence of damage? Leaves blown off? Broken or bent plants? Are some kinds of plants damaged while other are not? Can you figure out why?
4. Which leaf types are lying on the ground *after* a big wind storm?

FOLLOW THROUGH

☐ Not all leaves are the same shape. Do leaves that have the same area but a different shape fly at different speeds? Ask the kids to find two leaves of the same kind and the same size. Have them make one of these into a different shape and fly the two "leaves." Any difference?





☐ Have the participants check the flexibility of fast- and slow-flying leaves. Do slow leaves bend more when the wind blows forcefully on them? (Suggest to the kids that they try some large blades of grass.)

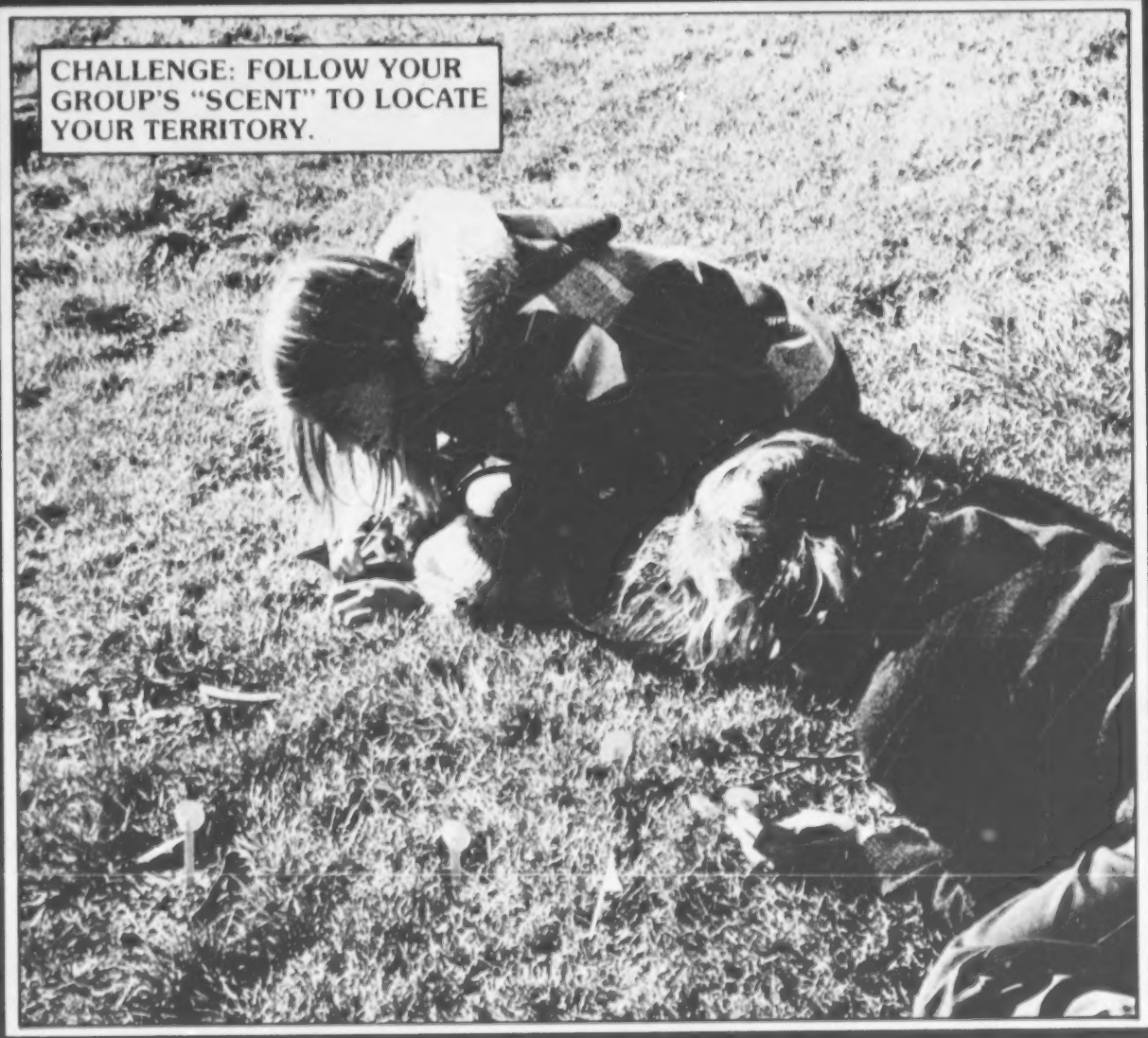
☐ Does wind influence the shape of plants? Check your area for trees and shrubs that are rounded off, or trees with branches on only one side. Can your group determine the direction of the prevailing wind?

☐ Can wind be beneficial to plants in any way? Tell the youngsters to look for such things as seeds or pollen blowing in the wind.

☐ Is it autumn? Not all leaves fly on leaf lines. To observe how leaves fly when they are free, play "catch a leaf." At the signal "GO!" competition starts and everyone tries to catch three leaves before they touch the gound. Sound easy? Try it! Are "fastest" leaves the hardest to catch? Are small leaves easy? Have the youngsters fly "hardest to catch" and "easiest to catch" leaves on their leaf lines to find out if there is a relationship. As the kids are gazing up into the branches, encourage them to watch for birds, squirrels, and other animals. How do they respond to the wind?

WHAT TO DO NEXT

Hold It	Set III
Pigment Puzzles	Set III
Seed Dispersal	Set I
Terrestrial Hi-Lo Hunt	Set I
Litter Critters	Set II
Sensory Hi-Lo Hunt	Set II



Many animals, unlike humans, rely on their keen sense of smell and their ability to produce specific scents to communicate with others. Scents are used to attract mates and to keep potential enemies away. Some animals use scents to mark home territories. A **territory** is the area an animal defends against others of its own kind. The area may be the possession of a single individual or a family group. Mammals use urine, feces, or substances from special scent glands as property signs to outline their territories. House mice, rats, and dogs mark their territories with urine. Male rabbits deposit a scent from chin and anal glands on the ground and bushes. The marking scent a deer uses comes from leg glands. These scent markers make the territory familiar to the owner and warn others to stay away.

In this activity, the youngsters explore their own sense of smell by following scent markers outlining their group's home territory.

MATERIALS

(For sixteen participants)

For flags:
120 small sticks (popsicle) or nails (10-cm long)

- colored construction paper, contact paper, or yarn (four colors)
- masking tape

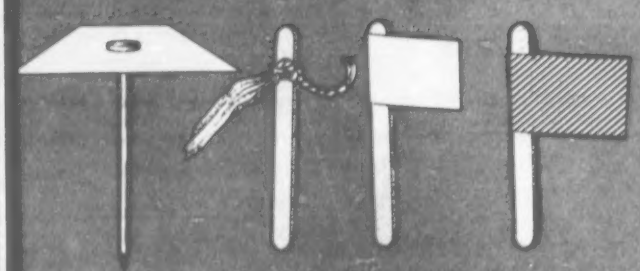
1 pair of scissors

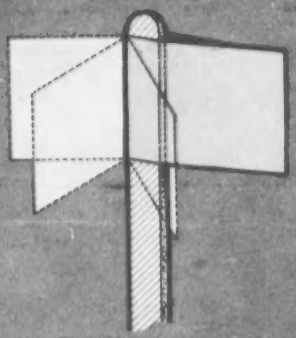
For scent markers:
6 thin kitchen sponges of two colors (e.g. 3 yellow sponges, 3 blue sponges)
4 bottles (29-ml size) of liquid extracts (four different scents, e.g. anise, coconut, peppermint, almond)
10 plastic bags (bread-loaf size)
10 plastic sandwich bags
1 liter of water

For the group:
3 large flags (for marking start/end points)
1 ball of string with at least 150 meters of string (optional)

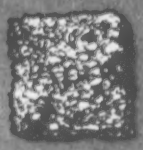
PREPARATION

1. Site. Select a lawn for this activity.
2. Prepare four sets of 24 flags each. Use a different color paper or yarn for each set. In addition, prepare for the demonstration two sets of 12 flags, each set of a different color. (It's OK to use two colors used in the previous sets.)





3. Cut the sponges into squares approximately 1.5 cm on a side. Keep the two colors separate. One sponge makes about 30 squares.



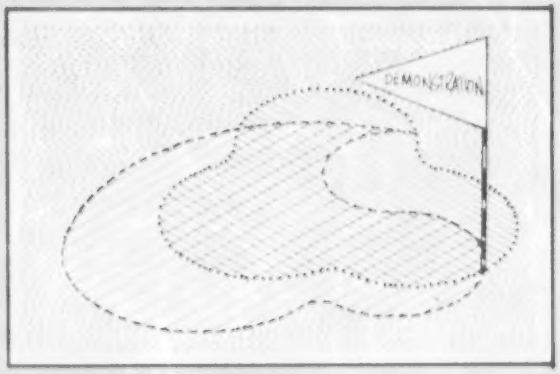
4. Package the flags and sponges in the larger plastic bags.

Each group of four participants receives:
1. 1 liquid scent
2. Bag 1, containing:
   1 sandwich bag with 13 blue sponge squares
   12 flags (all same color)
3. Bag 2, containing:
   1 sandwich bag with 13 yellow sponge squares
   12 flags (same color as in Bag 1)

For the demonstration game, you will need:
2 sandwich bags, each containing 13 sponge squares (all the same color)
2 sets of flags (each set a different color)
2 liquid scents (any 2 of the 4 you have)

5. **Scenting the sponges.** (Scent only the demonstration sponges; later you will show the youngsters how to scent their own.) Place your sponge squares (only one color), 2 capfuls of an extract, and 8 capfuls of water in the sandwich bag. Squeeze the bag so the liquid saturates the sponges. Repeat the process with another scent, using the second bag and its 13 sponges.

6. **Setting up the demonstration.** Just before the youngsters arrive, set up two overlapping scent territories using a different scent for each territory. Place the sponges about 1 meter apart. (Save one sponge of each scent for a reference sponge.) Flag one of the common points of the two overlapping territories. This will be the common starting point.



7. Select two areas at least 20 meters apart for the game. Each area will contain four overlapping territories.Place one large flag in each area to mark the common starting and ending point for the four territories.

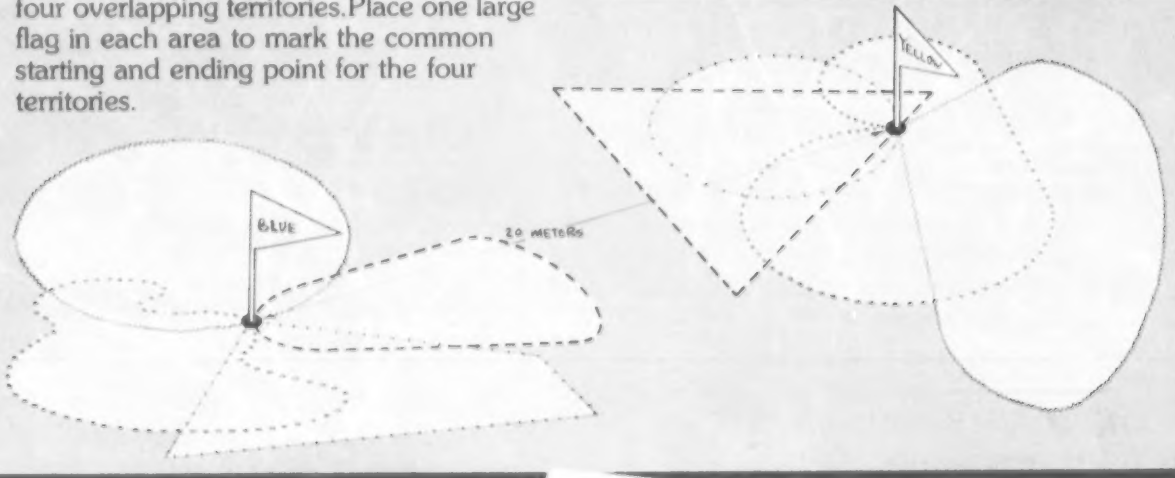
ACTION

Introduce the idea that many animals use their keen sense of smell and specific scents to communicate. Some animals set up invisible fences by marking a certain area with their scent. In this way an animal knows the boundaries of its **territory** (the area which the animal will defend against others of its own kind) and others know to stay away. Offer a few examples. Explain to the participants that they will play a game in which they mark and then find a group territory.

Demonstration

1. Divide the group into two temporary teams. Give each team one reference sponge and a set of 12 flags. Show them the starting point (flag) for the two territories you set up before they arrived. Challenge them to follow the scent, marking the outline of the territory with the flags as they follow the trail. Tell them *not* to touch the sponges with their hands (or noses). Encourage them to get down on their knees and sniff the sponges.
2. When all the flags are out, walk the outlines of your two territories as the youngsters watch. Clear up any problems and move on to the game.

→



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The Game

1. Divide the large group into groups of four and then divide each group into teams of two. (These numbers can be changed to accommodate more or fewer players.)
2. Introduce the materials by giving one group its scent and bags of materials: yellow sponges to one team of two and blue sponges to the other team. Demonstrate how to scent the sponges.
3. Distribute the rest of the materials and scents. After the kids have scented their sponges, describe the challenge.
4. Challenge each team to set out a scent territory that the other team with the same scent will be able to find. All blue-sponge teams establish territories in one area (point to "blue" flag); all yellow-sponge teams set up in a separate area (point to "yellow" flag). These flags mark the common starting/ending point for the territories. Each team uses 12 sponges, retaining the reference sponge. Tell the teams to place sponges about one meter apart.
5. After the territories have been marked, have the blue and yellow teams switch areas. Challenge them to find their scent and outline the territory with their flags. Encourage the teams to use the reference sponge to get the scent. Remind them not to pick up the sponges.
6. As a group, survey the flagged territories. Teams might want to connect all the same color flags with string to get a better outline of each territory.
7. Now have the group collect all flags and sponges. (You can wash the sponges for reuse by adding a cupful of bleach to a pan of water and soaking the sponges. Rinse thoroughly.)

MAKING "SCENTS" OF IT ALL

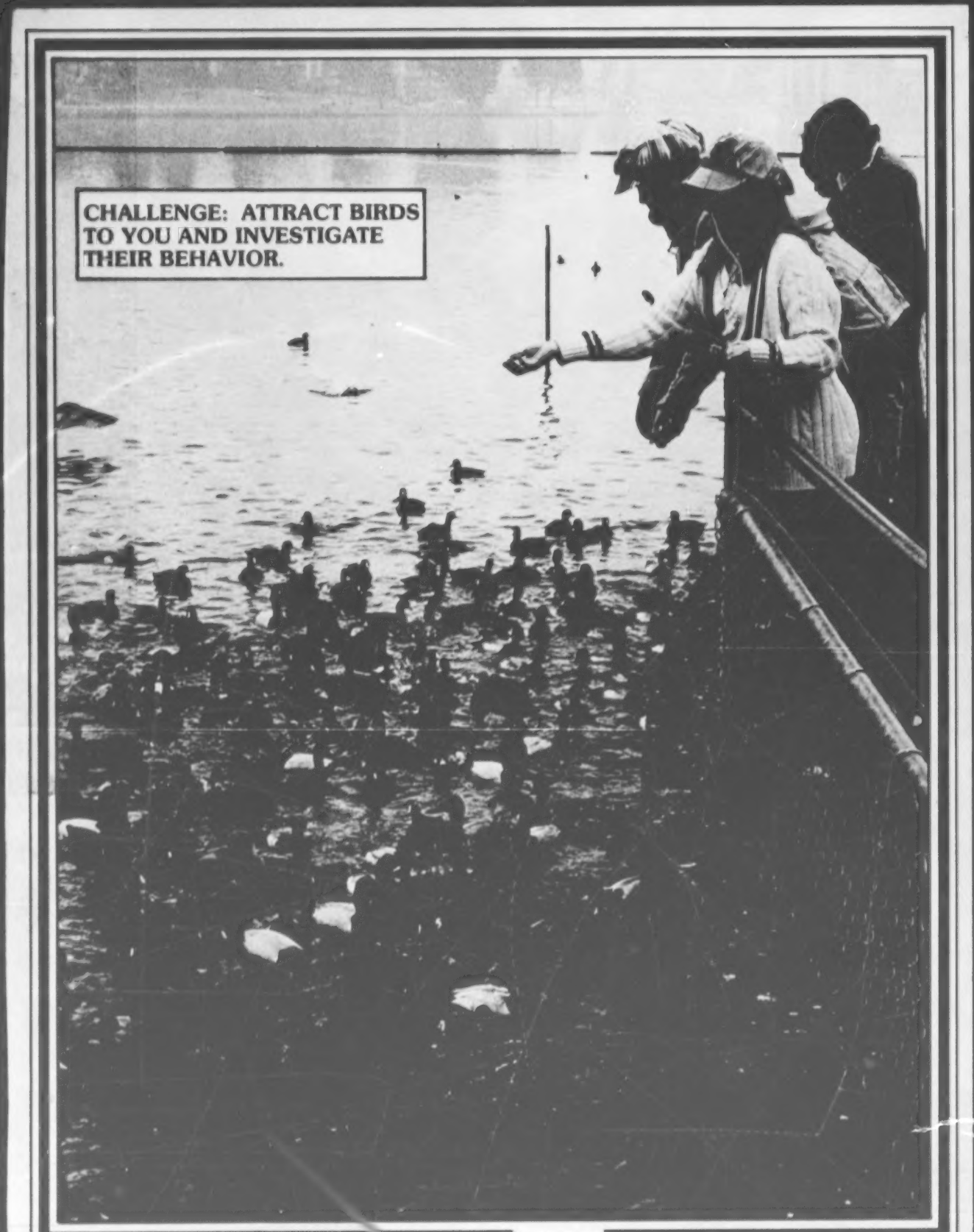
1. What sorts of problems, if any, did your group have in following your scent?
2. Which scents were easiest to recognize?
3. How do you think your sense of smell compares to that of a dog? A cat?
4. Are there any special scents around your home that make you feel comfortable? Can you recognize homes of friends by any particular scents?
5. Do humans set up territories? How do they mark them?

FOLLOW UP

Challenge the kids to find the sources of other distinctive scents in the activity site or along a hiking trail. Then ask the kids to pair up in buddy teams. One buddy closes her eyes while the other buddy guides her along the trail. The buddy being led tries to determine where she is by using only her sense of smell.

WHAT TO DO NEXT

Ants	Set III
Leapin' Lizards	Set III
Silent Stalking	Set III
Attention!	Set I
Sound Off!	Set II


CHALLENGE: ATTRACT BIRDS TO YOU AND INVESTIGATE THEIR BEHAVIOR.

Nearly everyone has fed birds at one time or another: perhaps pigeons in an urban setting, ducks in a park pond, or seagulls at the seashore. These three kinds of birds are especially interesting and easy to feed. Maybe you remember one especially beautiful bird or one whose behavior you found particularly curious.

Most people enjoy the almost personal contact that comes with feeding these animals. *For the Birds* encourages you and your youngsters to observe these interesting birds and, through feeding them, to discover more about them and their behavior. Families and small groups, as well as large groups of children, can enjoy this activity.

MATERIALS

Bird foods:

- bread (can be stale)

- popcorn (popped)
- sunflower seeds, chicken mash, or pigeon mix (available at pet shops)

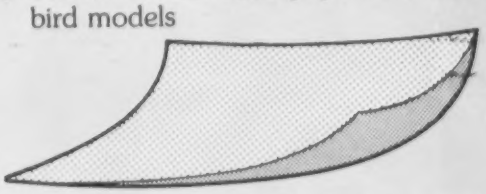
For each team:

1 sandwich baggy
1 set of Action Cards

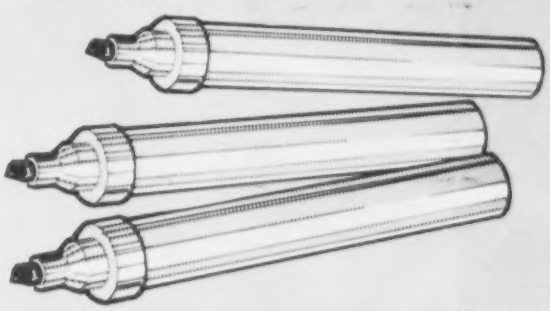
For the group:

1 master for Action Cards (2 sheets)
1 *For the Birds* "Model" Card
6 20cm x 20cm pieces of cloth

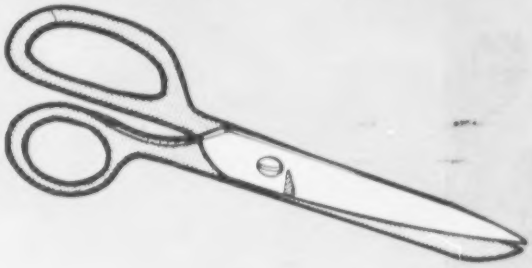
- colored construction paper for making bird models



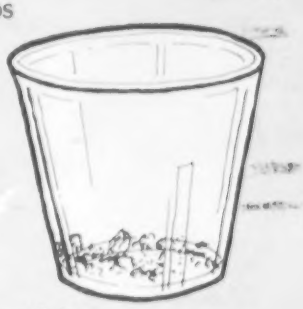
- marking pens — many colors



2 pairs of scissors



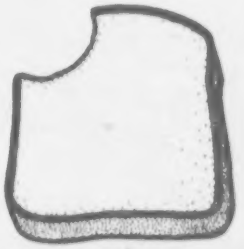
6 clear plastic cups



- clay for snake models

FOR THE BIRDS
Action Card #1

Offer two kinds of food to the birds at the same time. Which is their favorite?

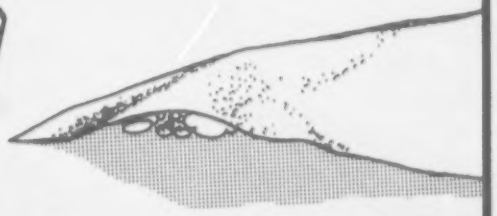


FOR THE BIRDS
Action Card #2

Get the birds to come as close to you as possible: **Warning:** Do not feed birds directly from your hand.

FOR THE BIRDS
Action Card #3

Put the birds' favorite food in a plastic cup. Do the birds find it? Hide the food under a cloth. Now can they find it?



FOR THE BIRDS
Action Card #4

In a group of birds, try to find one individual or kind of bird that gets most of the food. What happens when you try to feed the birds that are getting less food?

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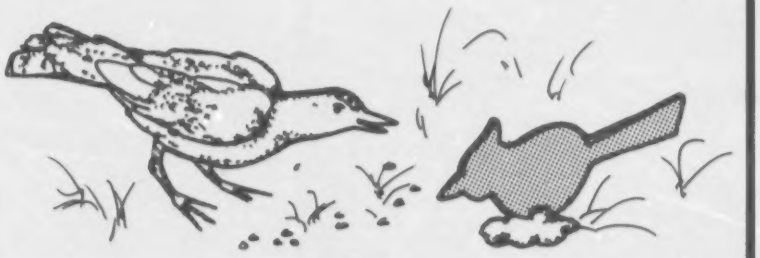
FOR THE BIRDS
Action Card #5

Make a loud noise while remaining perfectly still. Then *quietly* make a sudden movement. Which frightens the birds the most: the noise or the sudden movement?

FOR THE BIRDS
Action Card #6

Find out if clay snakes or paper bird models affect the feeding of your birds. If so, how?



FOR THE BIRDS
Action Card

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FOR THE BIRDS
Action Card

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FOR THE BIRDS

PREPARATION

Site selection. There are many places where birds regularly gather to be fed by picknickers or folks who just like to feed animals. These birds have learned to associate people with food, and such gathering places are the sites to look for.

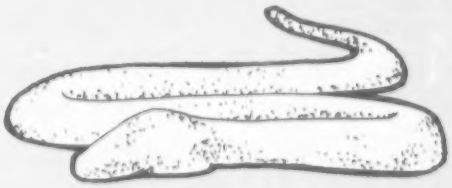
Pigeons are often found waiting for scraps and handouts in local parks, picnic areas, and downtown lunch spots. Pigeons are especially plentiful in cities where the ledges and cornices of tall buildings supply ample roosting places.

Ducks are commonly found in the ponds and small lakes located in most city parks. You can often find several kinds of ducks at the same site.

Scavenging seagulls frequent seashore picnic areas. These aggressive birds can also be found in coastal city parks.

For extra excitement, choose the site that has the largest number and greatest variety of birds.

Use the "Model" Card (found in the *OBIS Toolbox* folio) to prepare a snake and a bird model as examples to show your kids. (Bird and snake models are required for one of the Action Cards.)



ACTION

1. Call the youngsters together off to the side of the feeding area. Divide the group into teams of two and read the challenge. Point out any birds who might already be approaching you.
2. Distribute a set of Action Cards to each team. Explain that each card presents a different problem to solve.

Action Cards

- ☐ Offer two kinds of food to the birds at the same time. Which is their favorite?
- ☐ Get the birds to come as close to you as possible.
- ☐ Put the birds' favorite food in a plastic cup. Do the birds find it? Hide the food under a cloth. Now can they find it?
- ☐ In a group of birds, try to find one individual or kind of bird that gets most of the food. What happens when you try to feed the birds that are getting less food?

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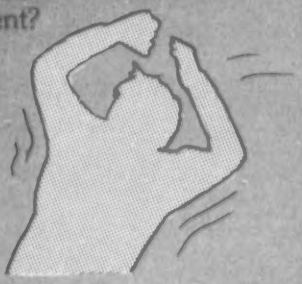
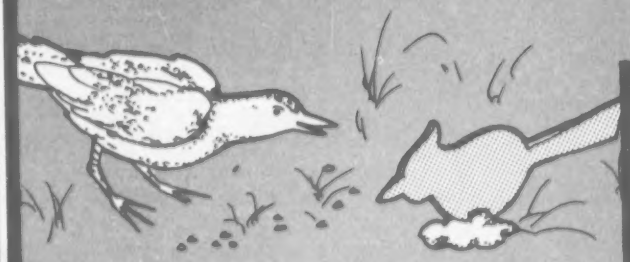
☐ Make a loud noise while remaining perfectly still. Then *quietly* make a sudden movement. Which frightens the birds the most: the noise or the sudden movement?



☐ Find out if clay snakes or paper bird models affect the feeding of your birds. If so, how?



3. Warn the kids not to let the birds eat directly out of their hands. (Some birds, especially geese, might nip a finger or hand.) Caution the kids to use only small amounts of food at any one time.

4. Point out your previously constructed models, the equipment, and the bird food. Tell the kids that everything they need to carry out the challenges on the Action Cards is there. (The kids can gather their materials now or come back and get items as they need them.) Distribute sandwich baggies for carrying food.

5. Let the teams spread out around the site, but stay in contact with them.

6. As the youngsters get involved in the action, grab some food and join in the activity. Move from team to team, sharing discoveries, questions, or approaches to a particular problem. This is especially helpful to kids who are used to working under the direction of a teacher instead of independently. Stimulated by the birds, many kids will raise questions of their own. Encourage the kids to answer their own questions by trying different ways of feeding the birds. When interest begins to wane or you run out of food, call a halt to the feeding.

7. After cleaning up, have everyone share their observations and discoveries about the birds. You may wish to focus the discussion on the challenges on the Action Cards. Did any of the teams have different answers to the same challenge? Do different kinds of birds prefer different foods?

SOME WILD IDEAS

While *For the Birds* deals with bird behavior, it also gives us the opportunity to share some feelings and ideas about animals.

1. Why is it so much fun to feed animals?
2. What does the term "wild" mean? Are the birds you were feeding wild?
3. What might happen if we continually provide food for the birds?
4. Do you think we could change an animal's behavior by feeding it? How?
5. What kind of animals, if any, do you think we *shouldn't* feed?

WHAT TO DO NEXT

Jay Play	Set III
Adaptation — Predator-Prey	Set I
Birdfeeder	Set II
Flocking to Food	Set II

Organisms living in streams, rivers, creeks, and marine sites that have wave action face a unique problem. They must withstand swiftly flowing water or be carried along with it. Many organisms have special shapes and structures that enable them to withstand this force. A stonefly nymph has legs with hooks, allowing it to cling tightly to submerged objects. The abalone has a broad, muscular foot that can exert a tremendous suction grip on underwater rocks. Kelps anchor themselves with strong holdfasts (anchoring structures) and have tough, rubbery bodies that bend but don't break with strong currents.

Settling in protected areas is another way organisms withstand currents. Clams burrow into mud or sand. Fish often stop in eddies or seek shelter among rocks, thus conserving their energy while they wait for the currents to carry food their way.

Specialized shapes, holding structures, and protection-seeking behavior are examples of adaptations for living in running water. An **adaptation** is any feature of an organism that improves its chances of survival and reproduction in a particular area.

OVERVIEW

In this activity, the kids construct and test models of organisms designed to withstand running water (**Part I**). In **Part II**, the youngsters investigate the holding structures and abilities of real organisms living in the running water.

MATERIALS

PART I

For each buddy team:
1 "body": cork or sponge (See **PREPARATION**.)
1 half-gallon milk carton

For the group:
1 "junk box containing: waterproof tape (electrical, duct, etc.), clay, bobby pins, paper clips, rubber bands, toothpicks, pipe cleaners, heavy thread or string, extra cork or sponge bodies
2 to 4 pairs of scissors

PART II

For each buddy team:
1 "container (milk cartons from Part I)
1 "bug box*
1 dip net (aquarium size)
1 plastic cup
1 Hold-It Trough

For the group:
1 "Hold-It Trough" Equipment Card
1 "Aquatic Observation Aids" Equipment Card

Optional:
*Pond Guides** (for freshwater sites)

*Available from the Lawrence Hall of Science. See the "OBIS Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Site. Select a stream, creek, shallow river, or rocky marine site. You will need water less than 40-cm deep for checking holding abilities. At marine sites, work during a low tide so intertidal organisms will be easier to locate. Sites with rocky bottoms generally have a richer variety of organisms than sites with muddy or sandy bottoms. See the *Leader's Survival Kit* for water-safety suggestions.

Equipment. Cut corks and sponges into a variety of shapes and sizes (ovals, squares, rectangles) up to half the size of a dollar bill. To make holding containers out of milk cartons, staple their pouring spouts closed and cut out the carton wall on the same side as the stapled spout. (See illustration.)

See the "Hold-It Trough" Equipment Card in the *OBIS Toolbox* folio for instructions on making and using the trough. Each trough takes about ten minutes to make. Let the kids help you gather milk cartons and make their own containers and troughs.

Time. Parts I and II require up to an hour and a half total. You may want to do each part on a different day.

ACTION

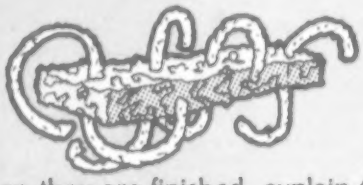
PART I CHALLENGE: CREATE AN ORGANISM THAT WILL WITHSTAND CURRENTS IN YOUR AQUATIC SITE.

Keep nets and troughs out of view or under your control until the second part of the activity.

1. Divide the group into buddy teams and limit the activity area to a safely manageable size (ten to thirty meters of a stream, creek, or shore line).

2. Stand by the water where everyone can observe, and hold up a cork or sponge. Tell the kids that the object represents a plant or animal that might live in the stream. Drop the "creature" into the water to show the kids how organisms can be washed away by currents.

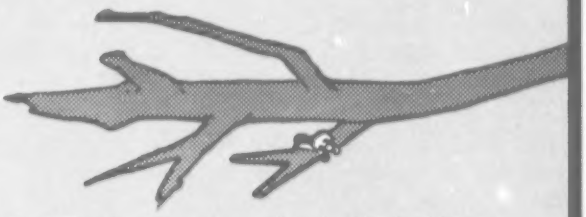
3. Hand out one creature to everyone and ask them to place their creatures in the water where they won't be washed away.



4. When they are finished, explain that they have just demonstrated one way organisms avoid being washed away: seeking a spot protected from the current's main force.

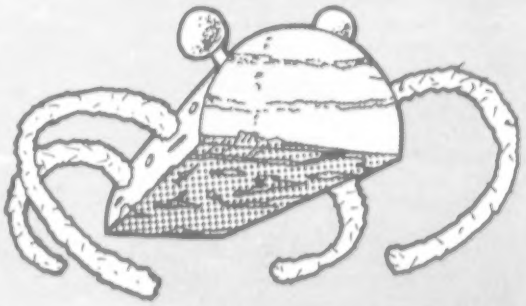
5. Now demonstrate the "flood test." Dump a milk carton full of water right next to one of the creatures. Dislodge several creatures with the flood test to point out the need for adding holding structures (such as legs, roots, or hooks) to the creatures.

6. Challenge the kids to add holding structures that will allow the creatures to withstand the flood test. Bring out the junk box and spread out the construction materials. Sticks, rocks, and other materials can also be used. Suggest that the teams pick something (a rock, log, plant) in the water for their models to hold onto before they add holding structures.



7. Ask the teams to check the holding ability of their creatures by placing them in a shallow and fast-flowing area or an area of surging water. Give each of the teams a milk carton to use for the flood test.

8. After everyone has checked the holding structures they created, mention that many organisms living in this water also have holding structures. These structures are called **adaptations** because they improve the organism's chances of surviving and reproducing in a particular area.



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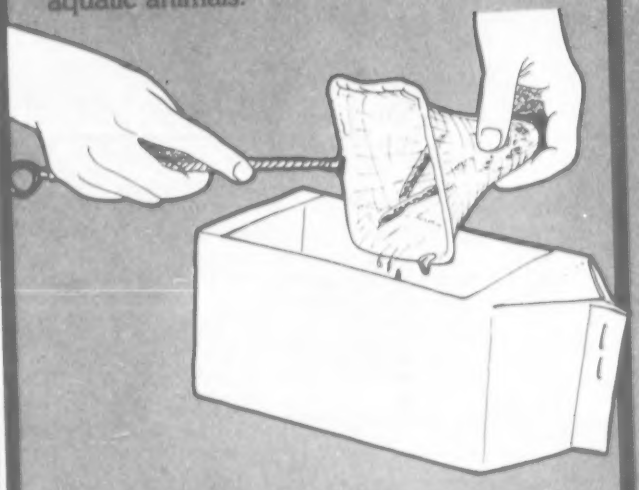
Outdoor Biology Instructional Strategies

PART II CHALLENGE: COMPARE THE HOLDING ADAPTATIONS OF ANIMALS LIVING IN YOUR SITE.

Introduce Part II by telling the kids that now they are going to examine the holding structures and behavior of animals living in the site.

1. Introduce and demonstrate the use of bug boxes, containers, and dipnets. (See the "Aquatic Observation Aids" Equipment Card in the *OBIS Toolbox* folio.) Hand out one set to each team. Then tell the kids to collect a variety of aquatic animals.



2. After ten to twenty minutes call the teams together and give them the opportunity to share their findings.
3. With a Hold-It Trough, a dipnet, and some of the captured animals, demonstrate the use of the trough. (See the equipment card.) Be sure to place some bottom materials in the trough.
4. Hand out one trough to each team and ask the teams to compare the holding abilities of their animals. Encourage the teams to look at the shape or structures (legs, suction disks, hooks) and at the behavior (strong swimming, diving for the bottom, crawling among rocks) of their animals as they hold onto or move through the troughs.

CURRENT THOUGHTS

When five to ten minutes remain in the activity period, call the teams back and ask them to describe the holding adaptations that they thought were most effective.

☐ Which animal(s) resisted the strongest currents?

☐ Where were the animals with strong holding abilities found? Did they live in the same parts of the site?

☐ What advantages might there be to living in swift currents?

☐ Ask the kids what adaptations they would like to have if they were to live in fast-flowing water.

Returning the organisms. Have the youngsters return the animals to the places they were taken from. Ask the kids to see how quickly the animals disappear from view.

FOLLOW THROUGH

1. Investigate pond animals and compare their behavior to the behavior of stream animals when both are subjected to currents.
2. Compare animals found in a fast section of a stream with those found in slower sections, e.g. a rocky bottom versus a muddy bottom.

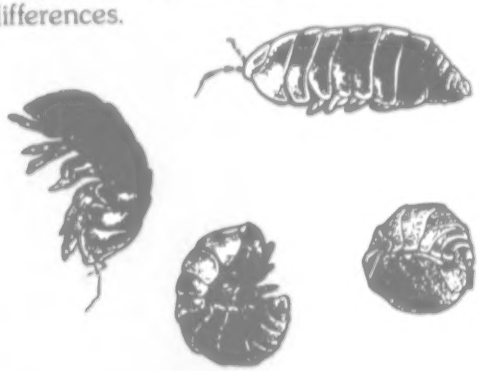
WHAT TO DO NEXT

Can Fishing	Set III
Silent Stalking	Set III
Water Striders	Set III
Great Streamboat Race	Set I
Invent an Animal	Set I
Water Breathers	Set II

CHALLENGE: INVESTIGATE THE
DIFFERENT BODY STRUCTURES
AND BEHAVIORS OF ISOPODS.

An animal's behavior is closely related to that animal's physical structure. **Behavior** is what an animal does. **Structures** are parts of an animal's body, e.g. feet, legs, tail, or antennae. The presence or absence and the shape and size of structures of an organism determine the kinds of things that animal can do. The wings of a bird enable it to fly. The broad, flat feet of a snowshoe rabbit enable it to run on the surface of soft snow. The hawk is able to catch and hold prey because of its sharp, hooked talons (claws). When a structure is necessary to the completion of a particular behavior, a **structure/function relationship** exists. An awareness of structure/function relationships can produce a better understanding of the special characteristics and abilities of living things. In this activity, youngsters learn about structure/function relationships by investigating isopods.

Have you ever seen an isopod? Perhaps while pulling weeds or looking under a rock you discovered a small, grey or black animal with many legs. You may have called it a pill bug, a potato bug, or even a roly-poly bug. These are all common names for isopods. At first glance they all look the same. A closer look, however, reveals several distinct differences.



The **pill bug** has a high domed body that enables it to roll into a tight, protective ball when disturbed. It is generally a slower runner than other isopods. When upside down on a smooth surface, the pill bug has difficulty turning over because of its domed body.

Another common isopod, the **sow bug,** has two tail-like appendages and a broad,

flattened body that allows it to flip over easily from an upside-down position. The sow bug cannot, however, roll into a ball as can the pill bug. The sow bug relies instead on speed to reach a place where it can hide from predators.

In this activity the youngsters hunt for and collect isopods. By making descriptive lists, the kids discover that there are *two* kinds of isopods. Next, by conducting a series of races that simulate isopods escaping from birds, the kids confirm behavioral differences between the two kinds of isopods. The concept of **structure/function relationships** is then introduced and related to the youngsters' experiences with isopods.

Note to leader: This activity requires two different kinds of isopods. See the **PREPARATION** section for details on locating and identifying the two types.

MATERIALS

For each youngster:
1 clear plastic cup, plastic bag, or baby-food jar
1 trowel, stick, or sturdy spoon for digging

For the group (about sixteen youngsters):
1 data board

1 marking pen
1 piece of string, 30 cm long
- several pieces of chalk

4 8½" x 11" pieces of paper
- scotch tape
- scissors
- hand lenses* or bug boxes*

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

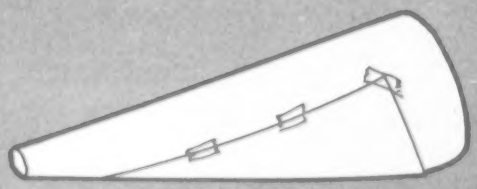
PREPARATION

Selecting a site. Sow bugs and pill bugs are commonly found together in the same site. Find a garden, a local park, or a vacant lot that contains both kinds of isopods. Make sure that the site you select has concrete sidewalks, hard packed dirt, or smooth asphalt nearby. This smooth, hard surface will be used as a racetrack.

Finding isopods. Look in dark, moist undisturbed spots with decaying plant matter. Such decaying matter is food for an isopod. Also look under boards, logs, rocks, piles of leaves, and grass cuttings. Dig into the litter beneath trees or on the forest floor. When you find an isopod, place it in your hand. If the isopod rolls into a tight ball, or is unable to flip over from an upside-down position, you have a **pill bug.** If the isopod has two tail-like appendages and quickly flips from an upside-down position onto its feet and runs, it is a **sow bug.**

Just before you start the activity, collect two or three isopods of each kind to use in introducing the activity.

Making "bird beaks." Roll and scotch tape an 8½" x 11" sheet of paper into a "bird beak" funnel. Cut off enough of the tip to leave a 2-cm opening. You will need one funnel for every four kids.



ACTION

1. Show your group the isopods you collected. Tell everyone that today they will be investigating these animals, but first they need to find some. Set the limits of the activity site and challenge the kids to find and bring back five to ten isopods each. Distribute digging tools and plastic cups or bags to hold isopods. Caution the kids to look carefully so as not to miss the isopods. Start the hunt and join in yourself. During the hunt make sure both kinds are being found. *(Don't tell* the kids that there are two kinds.) If only one kind is being found, direct the kids to spots where they can find the missing kind of isopod. Stop the hunt when each youngster has at least five isopods.

2. Move the group to the race site. Distribute hand lenses or bug boxes. Tell the kids to look closely at the physical structures and the behaviors of the isopods. Explain that a **structure** is any part of the isopod's body (e.g. tail or leg) and that a **behavior** is what an isopod does (e.g. runs, curls up). Tell the kids that you will list their observations on the data boards. By listing their observations, many of which will be conflicting (rolls into a ball, doesn't roll into a ball), the kids should soon decide that they have two different kinds of isopods. If they don't realize this, point out the conflicting observations and ask the youngsters if they might actually have two different kinds of isopods.

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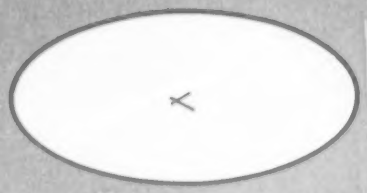
3. Have the kids choose a name for each kind of isopod. Perhaps pill bug and sow bug, or roly-poly and flat bugs.

The Race

1. Tie a piece of chalk to the end of a 30-cm piece of string. Use the chalk and string as a compass to draw several circular racetracks on the concrete or asphalt. Make one racetrack for each group of four kids.



2. Introduce the races as a way of investigating the behaviors of the two kinds of isopods. Describe the race as a simulation in which isopods are dropped by a hungry bird and try to escape being eaten.

3. Show the youngsters how to start a race by dropping one of each kind of isopod through the paper "bird beak" funnel into the center of the racetrack. Lift up the funnel and cheer on your isopod hero. The first isopod to reach the outside line is the winner. No flipping over of upside-down isopods! To avoid confusion, race only two or three isopods at one time.

4. Each race takes little time so let everyone have several isopod races. Encourage challenge races between winning isopods.

5. Call a halt to the races shortly before your activity period is over. Discuss the different escape behaviors of the sow bugs and the pill bugs. Ask the kids to suggest which isopod structures (e.g. domed body, broad flattened body, tail-like appendages) are needed for the different escape behaviors. Introduce the **structure/function** concept.

WHAT DO YOU THINK?

1. Which kind of isopod won most of the races? Why do you think those isopods won?
2. What effect did the size of the isopod have on its finishing position?
3. How do you think slow isopods protect themselves?
4. Suggest some human structure/function relationships.
5. Can you think of some human body parts or structures that have no function? What are they?
6. Be sure to have the kids return the isopods to the places where they were captured.

FOLLOW UP

1. **Further Races.** Race the two kinds of isopods on a different kind of track. Try gravel or grass. Do the behaviors of the two kinds of isopods change?
2. Release some isopods on blades of grass. Which kind of isopod is easier to see in the grass?

WHAT TO DO NEXT

Ants	Set III
Hold It	Set III
Adaptation—Predator-Prey	Set I
Seed Dispersal	Set I
Hopper Circus	Set II
Litter Critters	Set II

Many animals can distinguish between colors. They use color as we do to recognize foods and to distinguish between those that taste good and those that taste bad. Humans learn by tasting that black jelly beans have a licorice flavor while other colors have other flavors. If we like the taste of licorice, we can choose the black jelly beans. If we do not like licorice, and we associate black with licorice flavor, we know to avoid the black ones.

Many birds also use color to recognize foods. Jays learn that brightly colored Monarch butterflies taste bad. After one taste, jays will not eat Monarchs again. They will, however, sample butterflies that are colored differently. Cedar waxwings and robins ignore green, unripe holly berries, but greedily devour the berries after they ripen and turn red.

In this activity the birds to watch are jays. Jays are common, bold birds whose lack of shyness and relatively large size make observation easy. Jays also eat a wide variety of foods and are frequent scavengers at picnic areas and camp sites. Offering them human foods such as macaroni will not alter their feeding habits or harm them.

Jay Play works best with small groups, preferably a maximum of ten children per adult at any one site. It is also an excellent activity for adult or family groups. This activity is based on observation of bird behavior. Because the activity requires patience, it is a good activity for a lunch or rest period when the group is relatively quiet. The birds sometimes need ten to fifteen minutes to discover the bait.

CHALLENGE: FEED JAYS AND FIND THE COLOR OF FOOD THEY PREFER. TRY TO CHANGE THIS PREFERENCE BY ALTERING THE FLAVOR OF THE FOOD OF THE PREFERRED COLOR.

Gray Jay

MATERIALS

For each group of ten:

1 eight-ounce package of elbow macaroni (cooked: see **PREPARATION** section)
- food coloring — red, green, blue, yellow

6 plastic produce bags
1 data board
1 marking pen
- salt
- other flavorings such as cayenne, pepper, hot sauce, mustard, almond extract

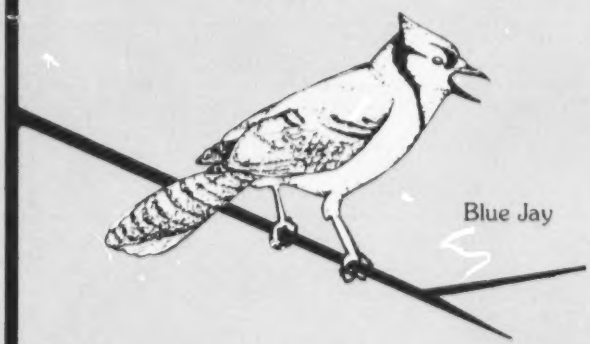
2 to 3 mixing containers, e.g. milk-carton halves
- paper towels for wiping hands
- stick or spoon to use in mixing
- wrist watch
- duplicated Action Cards

1 master of Action Cards (2 sheets)

Optional:
- binoculars
- field guides to local birds

PREPARATION

Select the site. Check out possible sites where jays gather. Picnic or camping areas, parks, or established bird feeders are often good places. Select a site where at least five jays readily go after food that you set out. Identify one highly visible bait station, such as a low limb, a bench, or a flat rock, to be used by the entire group.



Blue Jay

Prepare the bait. Precook an eight-ounce package of elbow macaroni *without adding the salt to the cooking water.* When the macaroni is tender, divide it and the cooking water into six equal parts. Set aside two parts of macaroni. Place the remaining four parts into separate bowls. To each bowl add one teaspoonful of a different food coloring. Stir until the dye covers all the macaroni. If the macaroni is not a bright, rich color add a little more coloring. Let the macaroni sit for ten to fifteen minutes. Rinse each color of macaroni *separately* in a collander, drain, and package each in a separate plastic bag. Package the leftover white macaroni in two bags. Refrigerate the macaroni until you are ready to use it. Use the prepared macaroni within five days.

Duplicate enough Action Cards for each team to have one card.

JAY PLAY
Action Card

Do two birds feed at the same time?

OR

Do they eat one at a time?

JAY PLAY
Action Card

What do the birds do with the food after they pick it up?

How many times do they:

eat it? _____

fly away? _____

bury it? _____

JAY PLAY
Action Card

How many different birds did we attract to the food? _____

Were they all the same kind? _____

If not, how many different *kinds* were there? _____

98

JAY PLAY
Action Card

How many food pieces do the birds pick up at once?

1 2 3 4

99

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JAY PLAY
Action Card

How long do birds stay by the food before they fly away?

JAY PLAY
Action Card

What appears to be the birds' favorite color of food?

Favorite Color_____

Second Favorite Color_____

JAY PLAY
Action Card

Are the birds communicating with each other by . . .

calling to each other?

looking at each other?

doing something else?

What?

100

JAY PLAY
Action Card

How do the birds approach the food?

go right to it_____

look around a lot _____

sneak in _____

101

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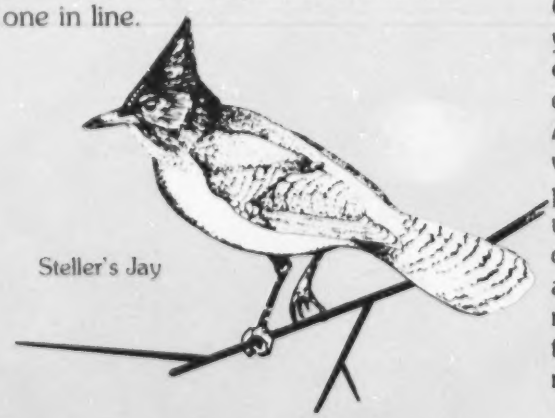
ACTION

1. At the jay site, show the youngsters the colored macaroni and explain that it will be used as bait to attract birds. To

Piñon Jay

get the youngsters thinking about preferences in food color, ask: "How does the color of food affect your decision to eat it?" "How would you react to black mashed potatoes or blue chicken?" Encourage a short discussion of how, through experience, we expect certain foods to be a certain color. Ask the youngsters how they think birds might learn such things. Then read the challenge to them.

2. Divide the group into five teams. Give each team a different color of macaroni, retaining one package of white macaroni for future use. Point out the bait station you have selected for placement of the macaroni. Then have the teams alternate the colored pieces of macaroni in a line like a string of Christmas tree lights, i.e. so that all pieces of one color are not clumped together. Each piece of macaroni should be about 4 cm from the next one in line.


Steller's Jay

3. As soon as the youngsters finish putting out the macaroni, have them sit in a group at least six meters away from the food. Caution them to be quiet and have patience. One youngster should note the time the trial begins to see how long it takes for the first birds to come to the macaroni.

4. Distribute one Action Card to each team. Each card gives different observation instructions. The teams can share their observations at the end of the session.

5. Tell each team to keep track of how many of its color of macaroni have been eaten. As soon as eight pieces of one color are gone, end the trial. Have each team record on the data board how many pieces of its color were taken. Ask the group which color the jays preferred. Suggest to the group that they conduct a second trial like the first one. (A second trial serves to reinforce the color preference in the jays and allows the youngsters to catch action they may have missed in the first trial.)

Scrub Jay

6. After the second trial ask the youngsters to use the data they recorded on the data board to determine which color the birds prefer. (Usually it is white.) Ask the youngsters if they can think of ways to change the birds' color preference in macaroni. Among the ideas usually suggested is making the preferred color taste bad. Show the teams the salt and explain that adding salt to the white macaroni will *not* change the color, just the taste. Give the white-color team a mixing container, the salt, and a mixing

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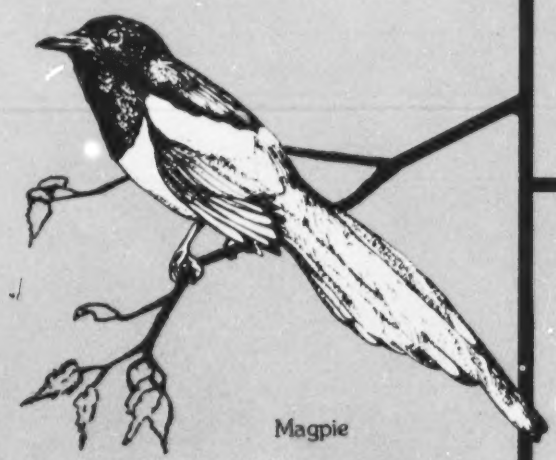
stick. Make sure that enough salt is added to completely coat the macaroni pieces. Use some of your reserved white macaroni if it is needed.

7. If jays do not prefer white macaroni have the children add one of the other flavors to the preferred color of macaroni. (The white salt will change the color of the dyed macaroni as well as the taste.)

8. After the preferred color is altered in taste, conduct a third trial similar to the first two trials, but using the salted or flavored macaroni in place of the plain-flavored macaroni. After eight pieces of one color are eaten, record the results on the data board. Be sure to indicate which color was salted or flavored.

9. Conduct one or two more trials as interest permits. If the birds will not eat the salted or flavored macaroni, encourage the group to conduct another trial using only plain-flavored pieces of the preferred color of macaroni. Record the results. Did the jays learn to avoid what was once their favorite color, even though it now tasted good?

10. Before the session ends, have the teams share their Action Cards and findings with the group. Encourage everyone to contribute any behavior or information they observed.



Magpie

JAY SQUAWKS

1. Do you think jays can learn? How well did they learn and how quickly?
2. In what other ways is color recognition important to birds or to humans?
3. Why do you suppose jays are willing to try foods that they normally don't eat?

FOLLOW THROUGH

This activity usually prompts youngsters to further explore color preferences or jay behavior. Some suggested challenges are:

1. Find out if jays prefer different colors of food in different locations. Do they seem to like one color on the ground and another color in the branches?
2. Discover if jays will eat macaroni of a non-preferred color if it is the only color available.
3. Use food to bring the jays as close to you as possible.
4. Find out which kind of food the birds prefer when they must select from a number of foods of the same color. For example, conduct a trial using all white-colored foods such as macaroni, bread (without crusts), turnips, popped popcorn, and potatoes. After a food preference has been determined, try to change the food preference by salting the preferred food.

WHAT TO DO NEXT

For the Birds	Set III
Attention!	Set I
Who Goes There?	Set I
Birdfeeder	Set II
Flocking to Food	Set II

The conspicuous artifacts of our affluent culture decorate our environment. Cans and bottles adorn roadsides while paper bags and newspapers flutter on fences and shrubs. Familiar sights around every building include the inevitable wrapper, empty package, plastic-this and metal-that. This fugitive refuse, set free by someone's thoughtlessness, has become part of the ecosystem. Many consider this refuse to be pollution. But is this man-made litter really pollution? Many small animals use cans and crumpled paper for homes. Often a piece of paper, unceremoniously introduced into an environment, provides a meal for a cluster of isopods or a passing slug.

LOOKING AT LITTER

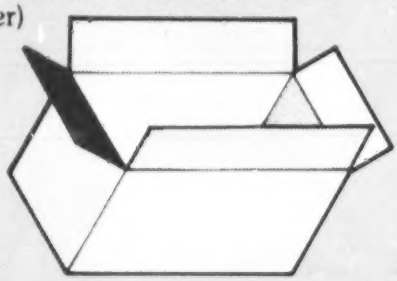
In this activity, the youngsters examine the litter in the site and, using the evidence they uncover, decide whether litter is a problem in the environment. The activity does not advocate littering or cleaning up litter. Litter may be removed during the course of the investigation, but this decision should be left up to the participants. After all, how would you like someone "out there" judging your home to be undesirable and hauling it away to an "appropriate" place? No matter what decision your youngsters make, they probably will be surprised by the numbers and variety of animals living in their litter collection.

CHALLENGE: FIND OUT HOW ANIMALS USE MAN-MADE LITTER IN THEIR ENVIRONMENT.

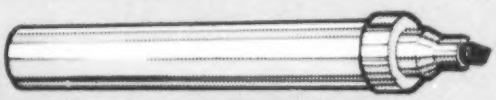
MATERIALS

For the group:

4 large cardboard boxes (6 if site is rich in litter)



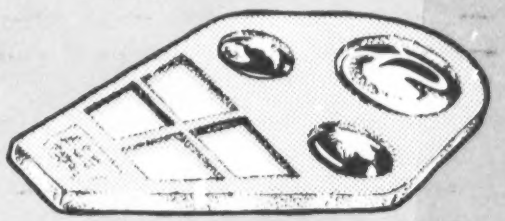
1 marking pen



Optional:

6-8 white-bottomed containers (milk-carton halves)

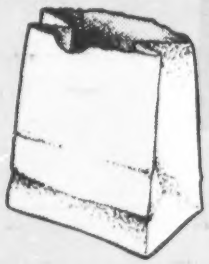
6-8 magnifiers*, or



6-8 bug boxes*

Alternate Collection Method:

1 medium paper bag per youngster



*Available from the Lawrence Hall of Science. See the "OBIS Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Select a site that contains an ample supply of man-made litter. The longer the litter has been in the site, the more animals you are likely to find.

ACTION

1. Gather at your littered site. Invite the youngsters to look around the area. Draw attention to the litter by asking if anyone noticed the papers and cans. Ask the participants what effect they think the litter has on the **organisms** (animals and plants) living in the environment. Tell the group that one way to find out is to collect the litter and examine it.

2. Define the boundaries of the area to be "de-littered" by the group, and divide the group into teams of two to four youngsters. Give each team a box and send the teams out to collect all of the litter.

3. When the participants have collected the litter, call them back to look over their spoils. Encourage each kid to look at, into, and through a piece of litter to see if there are any animals living in it. With any luck at all someone will almost immediately find some insects or other small animals.

4. Suggest sorting the litter according to whether or not there is anything living in it. Condense the four boxes of trash into two boxes, and label the empty ones "With Life" and "Without Life." If your site is particularly rich in litter and you have extra boxes, use them for additional "With" and "Without" boxes.

5. If you use the optional white-bottomed containers and magnifiers, put them in a central location. Encourage the kids to place organisms from the litter into the white-bottomed containers and then place the piece of litter in the "With Life" box. Litter that does not contain organisms should be placed in the "Without Life" box. Allow plenty of time for this part of the activity, encouraging the youngsters to look closely at the organisms found and to share their discoveries with each other. Make sure that all organisms are returned to the environment at the end of the activity.

Alternate Collection Method
If your site has only a small amount of litter, and you want to be sure the youngsters have the opportunity to observe the animals lurking therein, use the "sort as you go" method. Form teams of two and give each team two paper bags, one labeled "With Life" and one "Without Life." Have the teams investigate each piece of litter as they go, and place it (and its organisms, if any) in the appropriate bag. When you call the group back together, the "Withs" and "Withouts" can be condensed into large boxes and discoveries shared.

GIVE IT A "LITTER" THOUGHT

☐ Look over the "With" and "Without" piles of litter. What kinds of litter do animals use? (Paper, cloth, cardboard.) What materials are not used by animals? (Plastic, glass, metal.) Some "With" and "Without" separations display this materials preference very clearly – others less clearly.

☐ **Mini-Habitat.** Each litter item and its immediate surroundings make up a mini-habitat. Have the youngsters describe the conditions in some of the litter mini-habitats, e.g. warm, dry, moist, cold, humid.

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☐ Look through the "With" pile for evidence that animals have been eating litter (part of the process of natural recycling). Which kinds of litter are being recycled (eaten) and which are not?

Does the group think any changes should be made in the materials used for disposable packaging and beverage containers? What kinds of changes?

☐ Consider aesthetics. Does your site look better with or without litter?

☐ What might happen to the animals you found in the litter if you remove the litter? Will they find natural homes? (See the **FOLLOW THROUGH** section.)

☐ What effect does litter have on plants? Were plants growing in litter? Under litter?

A CONTROVERSY: RETURN IT OR TRASH IT?

You have a collection of litter: some that supported life and some that did not. Ask the group what should be done with the litter. If *everyone* feels that it should be either returned to the site or removed to a trash can, follow this decision. However, if some feel inclined to return some of the litter, and others want to dispose of it, form two sides to the controversy. Have the "return it" faction prepare a list of reasons why the litter should be returned, and the "trash it" faction prepare a list of reasons why it should be trashed. Allow three minutes for list completion. Then have a spokesperson for each faction state its point of view, using the list of reasons. Let the teams rebut at the end of each presentation. Work out a solution to the problem. Act on the decision.

FOLLOW THROUGH

☐ Find out where your litter animals live besides in the litter. Look for their natural homes in an unlittered site. Release some litter organisms and see where they go.

☐ Repeat the activity in a different environment: seashore, city, farm, city park, or trail. Do you find the same kinds of animals using litter for homes?

☐ Do you find more animals in litter when the weather is cool and moist or warm and dry? If your site is dry, moisten a section for a couple of days and compare discoveries with a dry area.

WHAT TO DO NEXT

Can Fishing	Set III
Isopods	Set III
Web It!	Set III
Natural Recycling in Soil	Set I
Litter Critters	Set II

For this activity, you can work with any of the more than twenty-five species of blue bellies found in the continental United States or with the American Chameleon, which lives in the southeast. Blue bellies have many names; they are called swifts, rough-scaled lizards, and fence lizards in different parts of the country. Blue bellies and chameleons are relatively small lizards that can grow to about 10 cm in length, not counting tail length. They feed on a variety of insects and spiders, but their favorite prey are flies and ants. These lizards are active predators and will attempt to eat almost any small object (cricket-size or smaller) that moves near them. They often jump to catch their prey, and the chameleon sometimes leaps distances several times its own length to snatch a meal.

Male blue bellies have intense blue markings on throat and belly; females are less brilliantly colored. Chameleons have the ability to change color between various shades of green and brown. Male chameleons have throat fans (loose throat skin) that they flare out for display purposes, revealing the brilliant red color of the skin between the scales.

Male blue bellies and chameleons establish territories and defend them against other males. A **territory** is any area that an animal defends against other animals of the same kind. Male lizards warn other males to keep away by displaying their bright markings or throat fans, making threatening postures, and bobbing up and down with a movement that resembles push ups. If the displays don't drive off the rival, fighting may occur. Similar displays are used by males during the breeding season to attract females.

In this activity the kids use lures to attract lizards and then place lizards next to each other to investigate lizard interactions. Because both kinds of lizards are quick to hide when startled, you will have more success if you approach them with caution. For this reason, the activity works best with groups of two to six kids per leader. Playing *Silent Stalking* (Set III) is a good way to help your kids develop the walking skills they will need to get close to lizards.

CHALLENGE: INVESTIGATE LIZARD FEEDING BEHAVIOR AND INTERACTIONS BETWEEN LIZARDS.

MATERIALS

For each kid:
1 Lizard Rig

For the group:
1 "Lizard Rig" Equipment Card
1 junk box (bits of yarn, cloth, colored paper, foil, rubber bands, and other lure materials)
2 pairs of scissors

For Mark and Release:
- several vials of thick tempera paint (3 or 4 different colors)
- several small watercolor paint brushes

1 cup of water for washing brushes
2 to 4 magnifying lenses* (optional)

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Site. Lizards are most abundant during late spring, summer, and early fall. Choose the middle of a warm sunny day to look for good lizard sites and to conduct the activity. Select a site that contains a good number of lizards (one to two per buddy team). Finding a good lizard site is a good pre-activity task for the kids.

Blue bellies prefer sunny areas and inhabit grassland, chaparral, and open woodland areas. Favorite haunts include wood piles, dry creek beds, fallen trees, fences, old buildings, tree trunks, rocks, and brush heaps. American chameleons are climbers that prefer shady areas and are commonly found on trees, shrubs, vines, fences, and sides of buildings.

Safety. Because many kids are timid about handling lizards you may have to do most of the initial handling. Both blue bellies and chameleons may try to bite if they are handled roughly, but their bites are harmless, not even strong enough to break a person's skin. Even so, being bitten scares many people. Practice the handling procedures outlined in the "Lizard Rig" Equipment Card (in the *OBIS Toolbox* folio) so you can confidently show the kids how to handle lizards. *Stress gentle handling!*

ACTION

Lizards Feeding

1. Divide the group into teams of two or three. Set up at least ten meters away from the lizard area.

2. Locate a lizard and let the group approach to get a close look. Emphasize the slow, quiet approach.

3. Return to the preparation area and introduce the activity by telling the kids: "We're going to use lures to discover how lizards get their food and what they might eat."

4. Pull out a Lizard Rig and explain how it can be used to dangle lures near a lizard. (See the equipment card.)

5. Hand out the Lizard-Rig materials. After each team has constructed a rig, challenge the group to create lizard lures from the junk-box materials or from non-living materials around the site. Help any teams that are having trouble attaching lures to their lizard rigs. Emphasize once again that the lizards must be approached cautiously or they will scamper and hide.

6. Invite the kids to experiment with a variety of lures. When someone comes up with a "hot" lizard lure, encourage kids using less successful lures to compare the "hot lure" with their own. Try to see to it that everyone gets to see a lizard leaping and grabbing for a lure.

7. After fifteen to twenty minutes of experimentation with lures, call the teams together and ask them which lures were successful. What sizes, shapes, colors, and types of movement worked best? Ask the kids: "From the way the lizards reacted to the lures, how do you think lizards get their food? What do you think they might eat?"

Lizard-to-Lizard Interactions

1. Introduce the second challenge by asking the group if anyone observed two lizards together (within a few centimeters of one another). "Let's find out how lizards react when one lizard is placed next to another one."

2. Show the group how to tie a sliding noose on their Lizard Rigs and explain the procedure for catching lizards. (See the equipment card.)

3. Try to catch a lizard to demonstrate the noosing procedure. If you are not immediately successful, don't waste time trying to catch a lizard. Challenge each team to catch a lizard.

4. When the first lizard is noosed, call the youngsters back and demonstrate the handling and tethering procedure. (See the equipment card.) Encourage the kids to touch and handle the lizard. This is a good time to explain that the more brightly colored blue bellies or the chameleons that display a large red throat flap are probably males.

5. When two or three teams have captured and tethered a lizard, suggest that they try the following experiment when they locate a free (untethered) lizard.

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Lizard Experiment: Starting about one to two meters away, place a tethered lizard within sight of a free lizard and slowly move the tethered lizard toward the free lizard. At what distance does the free lizard react to the tethered lizard? What happens?

6. Encourage the teams to place their tethered lizard next to both a larger lizard and a smaller one. How do the lizards respond? See **LIZARD TALK** for other suggested questions.

7. Be sure to return the lizards to the places where they were found. If you can bring the group back to the site within a couple of weeks, you may want to mark several lizards before releasing them. (See the **Mark and Release** section.)

LIZARD TALK

Call the kids together to share their observations. Ask them to describe how the free lizards acted when a tethered lizard was slowly brought closer to them.

1. How did free lizards respond to large and small lizards? How were the responses different?

2. Did any fighting between lizards occur? What happened?

3. Why do you suppose some lizards bob up and down, arch their backs, and move so stiffly when approached by another lizard?

4. Were the encounters between males and females different than encounters between lizards of the same sex?

5. **Territories.** Explain that many animals, including dogs, cats, and many birds, set up certain areas and defend them against other animals of the same kind. Biologists call these areas **territories.** Suggest that one explanation for the displays and the attempts at driving away intruding lizards might be that lizards also set up territories and defend them. Ask the kids if they think people have territories. Ask the kids to explain their answers.

FOLLOW THROUGH

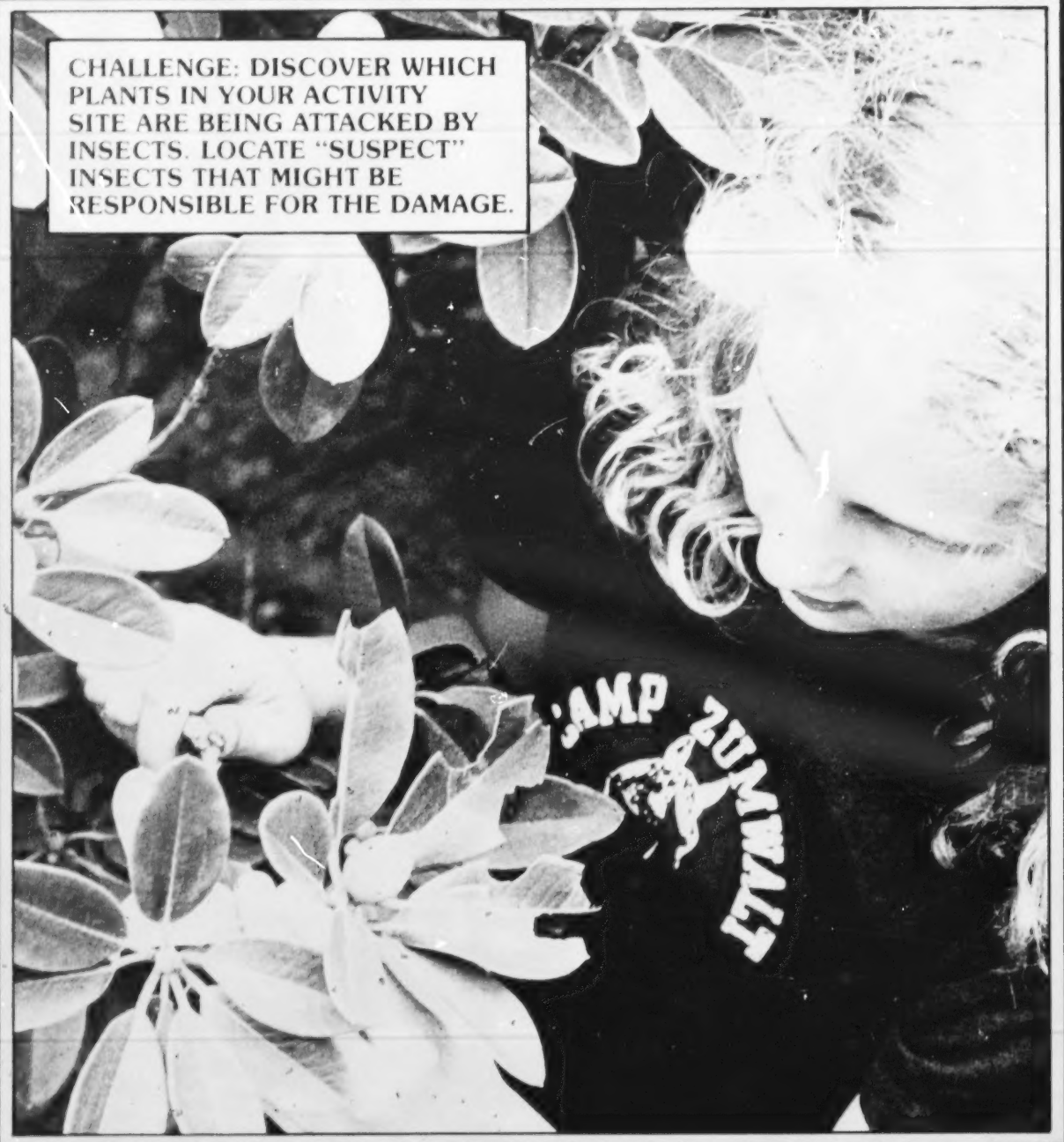
1. **Mark and Release.** Dab a small circle of paint on the base of each lizard's tail. Use a different color of paint for each lizard and mark that lizard's capture point with a dab of the same color of paint.

Release the lizards a few meters from their capture point. Visit the site over the next few days to see if any of the lizards have returned to their former locations.

2. Smile! You're on Candid Camera. An interesting follow up, if your kids have access to a camera, is for them to try to get a close-up picture of a lizard.

WHAT TO DO NEXT

Mystery Marauders	Set III
Water Striders	Set III
Adaptation — Predator-Prey	Set I
Invent an Animal	Set I
A Better Fly Trap	Set II
Attract a Fish	Set II


CHALLENGE: DISCOVER WHICH PLANTS IN YOUR ACTIVITY SITE ARE BEING ATTACKED BY INSECTS. LOCATE "SUSPECT" INSECTS THAT MIGHT BE RESPONSIBLE FOR THE DAMAGE.

Mystery Marauders is a good spring or summer activity.

Many animals eat plants. Large animals such as sheep, cows, and deer eat large amounts of plant material, frequently devouring plants right down to the earth. Small animals such as grubs, beetles, and grasshoppers eat much smaller quantities of plant materials as individuals, but their combined effect on plants is much greater due to their tremendous numbers.

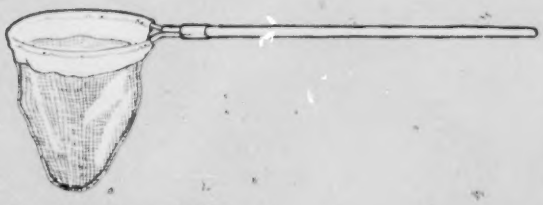
Multitudes of different kinds of insects attack almost every part of every kind of plant. The part of the plant insects most frequently nibble on is the leaf. Evidence left in the wake of feeding insects is quite varied. Some leave only twigs behind, consuming entire leaves. Some chew small round holes in leaves, and others make worm-shaped channels. Some work from the edge inward while others prefer to scrape away one surface of the leaf. To the trained observer, the method of attack on a leaf can be a clue to the type of animal feeding on the plant.

In *Mystery Marauders* youngsters assume the role of detectives and gather evidence of animals feeding on the plants in a vacant lot, meadow, or vegetable garden. After the evidence has been gathered, the kids return to the site to round up the "suspects" at the "scene of the crime." Finally, the youngsters attempt to catch some of the suspect's associates by organizing a "shake down" in the damaged area.

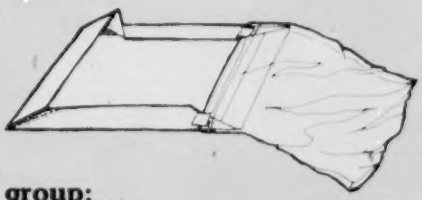
MATERIALS

For each youngster or team of two:

1 Action Assignment Card, duplicated from master (optional)
2 medium-sized plastic bags
1 magnifier* or bug box*



1 sweepnet, *OR*
1 Shake-It Container



For the group:

1 master of Action Assignment Cards
1 "Sweepnet" Equipment Card, *OR*
1 "Shake-It Container" Equipment Card

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

1. Select a site with "holey" plants. Check several different plants for holes in leaves or missing leaf edges.

2. If you are going to use the Action Assignment Cards, duplicate them in

MYSTERY MARAUDERS
Action Assignment Card

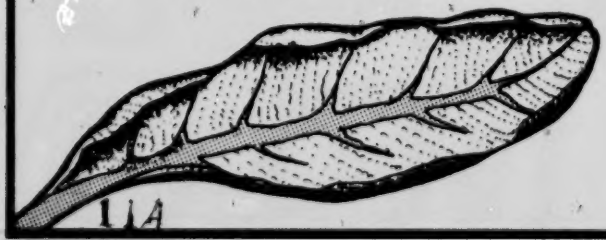
It has been reported that some mysterious animals are eating the plants in this area. Your Action Assignment, if you choose to accept it, is to gather some leaf samples as evidence that this is true. Look for leaves with holes in the *middle*.

MYSTERY MARAUDERS
Action Assignment Card

It has been reported that some mysterious animals are eating the plants in this area. Your Action Assignment, if you choose to accept it, is to gather some leaf samples as evidence that this is true. Look for leaves that have the *edges* chewed away.

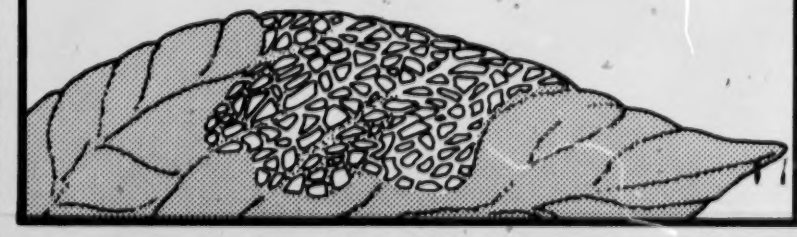
MYSTERY MARAUDERS
Action Assignment Card

It has been reported that some mysterious animals are eating the plants in this area. Your Action Assignment, if you choose to accept it, is to gather some leaf samples as evidence that this is true. Look for *curled, browning,* or *shriveled* leaves.



MYSTERY MARAUDERS
Action Assignment Card

It has been reported that some mysterious animals are eating the plants in this area. Your Action Assignment, if you choose to accept it, is to gather some leaf samples as evidence that this is true. Look for *surface scraping* on the leaves.



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advance.

3. If you are going to make nets or Shake-It Containers, do so in advance. (See the "Sweepnet" and "Shake-It Container" Equipment Cards in the *OBIS Toolbox* folio.) Nets work best in areas of grassland or low shrubs. The Shake-It Containers work well with bushes, shrubs, and trees.

ACTION

You can introduce the activity either verbally or with Action Assignments, which are more specific and usually work better with older kids.

1. **Introducing the activity.**

a. **Verbally.** At the activity site, say: "It has been reported that a mysterious animal has been eating plants in this area. (You may want to show them one leaf with holes.) Your assignment is to take a plastic bag and gather some leaf samples as evidence that this is true." Tell the kids to take five to ten minutes to complete the assignment and bring in the evidence.

b. **Written.** Distribute one Action Assignment Card and plastic bag to each participant or team. Tell the kids to take five to ten minutes to locate and bring in the evidence.

2. Look at the evidence. Spread it out for all eyes to see. How many different kinds of damaged plants were gathered as evidence? Which plant is most popular as a food source?

3. Challenge the kids to find out which animal was responsible for the damage. Send them back into the site with a lens or bug box to look closely for suspects at the scene of the crime. Tell the kids to look for animals in the act of eating leaves or at the site of the plant damage. Suggest looking in buds, on the tips of branches, on the undersides of leaves, and in curled leaves. Ask the kids to retain suspects in their plastic bags and share results with the other investigators. Did they identify any culprits?

4. The suspects now under surveillance may have undiscovered accomplices in the field. Organize a shake-down operation with your sweepnets or Shake-It technique. (See the "Shake-It Container" Equipment Card.) Demonstrate the technique(s) and send the kids out with plastic bags to bring in the suspects for observation.

5. **Informal line-up.** Call the group together to share discoveries. Have everyone put their "bagged" suspects in a line and look for interactions. Introduce leaves into some bags. Do any insects go to them? Eat them? Are any suspects attacking other insects (acting as predators)?

CHEWING THE RAGWEED

Wrap the investigation with a brief discussion.

□ Who did the dirty work? On what

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evidence do you make your judgment?

☐ What was the crime? Getting something to eat? Aren't we all guilty of that? What should the sentence be?

☐ Were you able to associate certain animals with certain kinds of damage?

☐ Did the shake down produce any animals (predators) that help keep the plant eaters under control? (Spiders, mantids, ladybugs, or others?)

☐ If no culprit was identified, why do you think you couldn't find one? Too hot? Too cold? Too light? Too early? Moved on?

FOLLOW THROUGH

☐ Plant-eating animals are known as "pests" when they dine on your vegetable garden. Set up a pair of similar gardens. Have the kids try to keep pests away from one garden (screening, hand picking, garlic spray, chickens, ashes) and let nature take its course in the other. Compare the results.

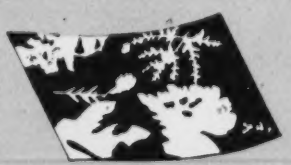
☐ Are some pests associated with only certain plants? Have the kids search garden plants to find out what is causing damage to various crops.

☐ Are there some plants that show *no* insect damage? Why might that be? Have the youngsters check leaf surfaces (tough, hairy) and the odors of such plants.

☐ Do animals attack parts of plants other than leaves? Suggest that the kids check fruits, limbs, bark, flowers, buds, and roots.

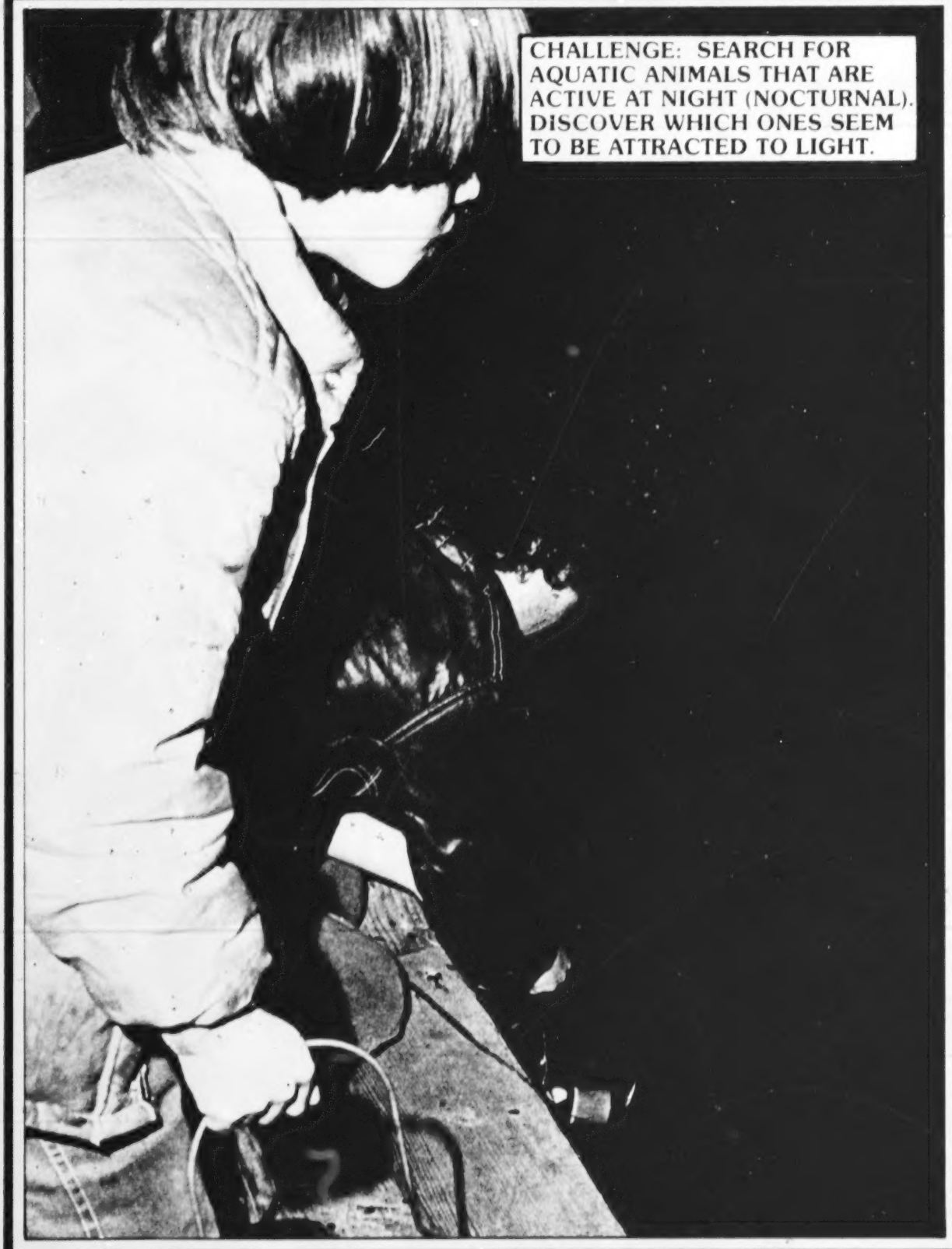
☐ What animals come out to eat plants at night? Bring the group back with flashlights and do the activity at night.

☐ Have the kids make sun prints (*Habitat Sun Prints*, Set I) of damaged leaves. The youngsters can use these for a record or to create a work of art.



WHAT TO DO NEXT

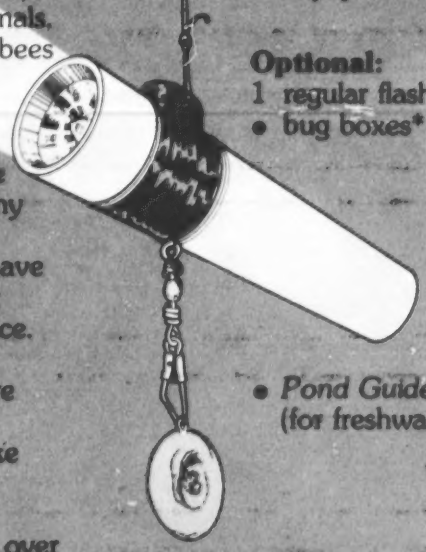
Shake It!	Set III
Swell Homes	Set III
Web It	Set III
Animals in a Grassland	Set I
Invent a Plant	Set I
Food Chain Game	Set II


CHALLENGE: SEARCH FOR AQUATIC ANIMALS THAT ARE ACTIVE AT NIGHT (NOCTURNAL). DISCOVER WHICH ONES SEEM TO BE ATTRACTED TO LIGHT.

Many animals are more active during the night than they are during the day. These animals are described as **nocturnal.** Animals that are mainly active during the day are **diurnal.** Skunks, many moths, raccoons, and bats are nocturnal animals. Humans, most birds, butterflies, and bees are familiar diurnal animals.

Nearly everyone knows that certain moths and other nocturnal insects are attracted to lights. There are also many nocturnal *aquatic* animals that are attracted to bright lights. Fishermen have long used powerful lanterns to attract squid and shrimp to the water's surface. For centuries Japanese cormorant fishermen have used small fires to lure fish within the diving range of their birds. Many other night fishermen take advantage of the drawing power of a bright light when they fish for bass, catfish, or panfish. A lantern hanging over the water may even lure large fish by first attracting the small organisms upon which the large fish prey.

In this activity the youngsters search for aquatic animals that are active at night and then use waterproof flashlights to discover which ones seem to be attracted to light.



MATERIALS

For each buddy team:
- 2 half-gallon milk cartons (one labeled "dark" and the other "light")
- 1 dip net
- 1 Night-Shine Flashlight (waterproof) with fresh batteries

For the group:
- 1 lantern (white gas or battery powered) to light the central discussion area

- extra flashlight batteries
- 1 "Aquatic Observation Aids" Equipment Card
- 1 "Night-Shine Flashlight" Equipment Card

Optional:
- 1 regular flashlight for each team
- bug boxes* or hand lenses*
- *Pond Guides** (for freshwater sites)

* Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Site. Choose a freshwater or saltwater site that offers easy water access and a fairly level shore, dock, or other surface from which to work. Because the group will be working at night and moving by flashlight, *footing should be secure.* Work in well protected areas such as coves, harbors, and bays if you plan to work around salt water. Low docks, piers, and quiet tidepools usually make exciting *Night Shine* sites. Calm, clear water will allow the kids to observe critters swimming through the flashlight beams.

Visiting potential sites and trying out the *Night Shine* techniques and equipment will help you choose a site that offers plenty of *Night Shine* action.

Safety. Because your group will be working around water at night, basic water safety becomes even more important. Clearly define the boundaries of the activity site. Explain and use the buddy system. (See the **SAFETY** section in the *Leader's Survival Kit* folio.) Life preservers are always recommended but especially when working from low piers or docks that stand over deep water (waist-high and up). Caution everyone to use care when moving about the site to avoid slipping, falling, or accidentally pushing someone into the water. We suggest a maximum group size of eight to ten kids per adult.

Equipment

1. For instructions on making observation containers out of half-gallon milk cartons, see the "Aquatic Observation Aids" Equipment Card in the *OBIS Toolbox* folio.
2. See the "Night-Shine Flashlight" Equipment Card for the waterproof flashlight set-up. Rig one waterproof flashlight for each team before starting the activity.
3. **Optional.** In addition to the waterproof flashlight, a regular flashlight for each team makes moving around easier.

ACTION

1. Set up the lantern in a spot that will serve as the central meeting area during the activity.
2. Explain the buddy system and assign partners. Caution the kids about the hazards of moving around at night (falling, slipping, tripping). Ask everyone to move slowly and carefully.
3. Point out the boundaries of the activity site and emphasize that everyone should remain inside the boundaries during the activity.

Searching for Nocturnal Aquatic Animals

1. Tell the youngsters they are going to search for aquatic animals that are active at night. Introduce the terms **nocturnal** and **diurnal** and ask for examples of both kinds of animals.
2. Show the youngsters how to use a dip net and transfer its contents into an observation chamber partially filled with water. (Refer to the "Aquatic Observation Aids" Equipment Card.)

3. Hand a dip net and an observation chamber labeled "dark" to each team. Challenge the teams to catch aquatic animals in the dark and place them in the "dark" observation chambers. If the teams have flashlights, tell them that the actual dip-net sampling should be done with the flashlights off. Let the teams search for critters in the dark for ten to fifteen minutes. (See the **NIGHT-SHINE**

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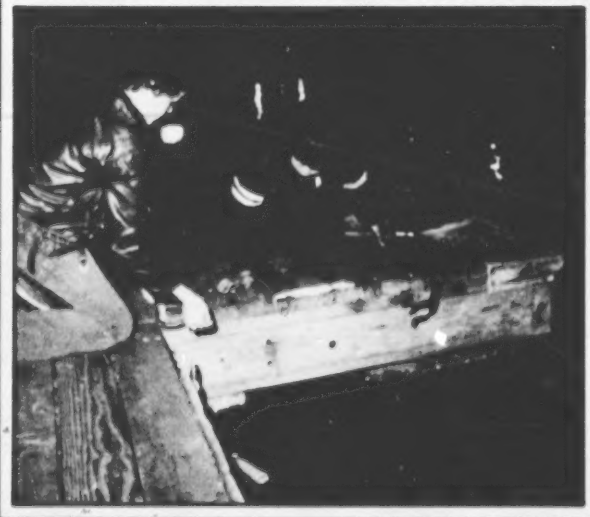
TECHNIQUE section of the equipment card for the dip-net sampling procedure.)

4. Gather near the lantern and give the teams a few minutes to share their findings. Bug boxes or hand lenses are useful for close-up viewing. How many different kinds of animals were captured? Save the "dark" containers and their animals for later review.

Searching for Light-Seeking Animals

1. Mention that some fishermen fish at night using bright lights to increase their catch. Tell the kids that they are going to see how the nocturnal animals living in this site respond to bright light.
2. Show the kids how to place a waterproof flashlight in the water so that the illuminated water in front of the flashlight can be sampled easily with a dip net. (See the "Night-Shine Flashlight" Equipment Card.)
3. Challenge the teams to catch any animals that swim into view. Distribute a container labeled "light," a waterproof flashlight, and a dip net to each team.
4. Let the teams flashlight-fish and place captured animals in their "light" containers until about ten minutes remain in the period. Then ask the teams to return to the lantern with their "light" critters and equipment.



LIGHT CONVERSATION

1. Ask the teams to take a look at the "light" critters and compare them with the "dark" critters. Were different animals caught in light than in darkness?
2. How did the "dark" animals behave (react) when exposed to light? How about the "light" animals?
3. Do you think the flashlights attracted the animals or did they just illuminate animals that happened to be swimming by? Ask the teams for evidence to support their views.
4. What advantages might a nocturnal animal have over a diurnal animal?

FOLLOW THROUGH

1. To determine if the animals your group captured are really nocturnal, return to the same site during the day and use dip nets and containers to see if the same animals are active.
2. Do *Night Shine* on a clear night with a full moon and on a cloudy, overcast night. Compare your results.

WHAT TO DO NEXT

Can Fishing	Set III
Web It	Set III
Who Goes There?	Set I
The Old White Sheet Trick	Set II
Water Breathers	Set II

CHALLENGE: SOLVE THE PLANT PIGMENT PUZZLES.

Color abounds in the natural environment throughout the year, but autumn is perhaps the most colorful time. Green leaves of elms, birches, and poplars begin to turn yellow, and leaves of oaks, maples, and sumacs start turning brilliant shades of red. Some fruits in the process of ripening, such as tomatoes, pumpkins, and berries, are changing colors too. Adding to this array are the colorful marigold and dandelion petals, which soon fade with the onset of winter frost.

The color we see in the plants is due to **pigments:** colored compounds in the plant tissue. Green leaves actually contain yellow pigments throughout the year, but they are hidden by the green pigments. In the fall, the amount of green pigment decreases and the amount of yellow increases. Some shades of red, purple, pink, and scarlet result from pigments that form in the fall due to chemical changes in leaves.

One way to investigate plant pigments is a scientific technique called "chromatography," which simply means to write with color. In this activity, your group explores the variety of plant colors and solves natural-pigment puzzles.

THE TIME AND PLACE

Autumn is a good time for *Pigment Puzzles*, but you can conduct this activity any time there are living plants with leaves, fruits, or flowers available in the site. (Be sure to obtain permission to collect plant samples.) Try to avoid areas with poison oak, poison ivy, or poison sumac. A yard or even a vegetable garden will work fine. An outdoor area sheltered from the wind is best for making pigment prints.

MATERIALS

For each team of two:

2 half-gallon milk cartons (for milk-carton containers)
2 coins (nickels, quarters, or pennies)
2 pencils or sticks

1 roll of transparent tape
1 thin piece of cardboard (old manila folder) to use as a rubbing surface

For the group:

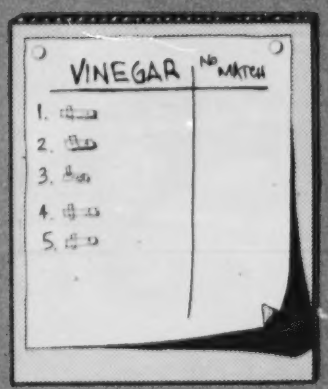
1 "Milk-Carton Container" Equipment Card
1 "How to Make a Pigment Print" Technique Card
1 package of cone-type coffee filters* (must be fine grained such as Rockline or Tricolator brands)
1 roll of clear plastic wrap
1 roll of masking tape
1 quart of acetone** (See **SAFETY** section.)
1 quart of white vinegar
1 pair of scissors
2 data boards
2 marking pens (different colors)
1 cm-ruler
1 pencil

* Available at grocery and coffee stores.
**Available at hardware, paint, and some drug stores.

PREPARATION

1. Prepare two milk-carton containers for each team, or have a few interested youngsters prepare them before the day of the activity. (See the "Milk-Carton Container" Equipment Card in the *OBIS Toolbox* folio.)

2. Make the pigment puzzles and the pigment-puzzle boards. (See the Making Pigment Puzzles section of the "How to Make a Pigment Print" Technique Card in the *OBIS Toolbox* folio.)



SAFETY

A word of caution is necessary regarding the use of acetone. Acetone fumes should not be inhaled; *work outdoors!* Acetone is also flammable. Read the label and warn the youngsters. The leader should pour the acetone into the containers and collect it in one labeled container at the end of the activity. Both the acetone and vinegar may be reused if they remain clear (uncolored).

ACTION

1. Explain to the participants that they will investigate pigments in plants. **Pigments** are colored compounds in plants that create the colors we see. Stimulate the youngsters' curiosity about plant color by asking some questions. "Most leaves and fruits are green during the growing season and then turn yellow, orange, and red. Do you think the yellow pigment might be hidden in a leaf and only appear in the fall when the green color fades? Or do you think the yellow pigment is a new product in the autumn leaf? What about the red pigments?"

2. Explain to the youngsters that they can separate different pigments in plants by using paper strips and two liquids. Caution the group about inhaling the acetone fumes. Demonstrate the entire technique with acetone. Emphasize that only a small sample is necessary to make a print. Show the group how to tape an identifiable piece of the plant sample to the top of the paper strip so the pigment print and sample remain together.

3. Challenge the participants to solve your pigment puzzles. Display the unlabeled prints and explain that they were made from leaves, fruits, and/or flowers. Make it clear that the same five plant samples are represented on both boards. Challenge the youngsters to find out which plant part was used for each print by making their own pigment prints.

4. Divide the group into teams of two. Give each team two labeled cartons (one "vinegar" and one "acetone"), two coins, two pencils, 15 filter-paper strips, a

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cardboard sheet (to use as a rubbing surface), and a roll of tape.

5. Help the teams get started. While they collect plant samples, pour the liquids into the cartons.

6. Encourage the youngsters to compare each finished print with the pigment puzzles to find a match. For a match, tape the print and sample next to the appropriate puzzle print. If a sample does not match the puzzle prints, tape the prints and samples to the "no match" section of each board.

COLORFUL CONVERSATION

Ten minutes before the end of the activity period, discuss the results.

1. Do all colors separate into more than one pigment? What hidden pigments did you find? Do you suppose these hidden pigments are in the plant all year round?

2. Which pigments moved up on the paper? How does the type of liquid affect the movement of the pigments in the same plant part?

3. Did you observe some pigments associated with certain parts of a plant? Which pigments were found more often in flower petals than in leaves or fruits? Why might this be?

4. Tear open a leaf that contained two or three pigments. Can you actually see the pigments?

5. Can you predict which hidden pigments will be in an untested plant? On what evidence do you base this prediction?

FOLLOW THROUGH

1. Try the same activity at a different time of the year.

2. Divide the group into two teams and have each team prepare pigment puzzles for the other team to solve.

3. On a day hike, have the kids collect a few interesting plant samples and investigate their pigments.

4. Bring in some other fruits, vegetables, or leaves from the store or a garden for the kids to test.

5. Ask the youngsters to use several different plant samples to make *one* print and see if they can separate all the pigments.

WHAT TO DO NEXT

Envirolopes	Set III
Attention!	Set I
Moisture Makers	Set I
Plant Patterns	Set II
Roots and Shoots	Set II

Shake It! can be conducted either in a standard OBIS activity format or as a hiking activity. Choose the format that suits your plans, and get shakin'!

A **community** is a group of plants and animals living and interacting in an area. Some communities, such as the community of living organisms in the Bering Sea, are huge. Other communities, such as those found on a cyprus tree, oak tree, or willow, are composed of fewer organisms and occupy much less space. Whatever the size and make-up of the community, certain factors are universal. A community contains plants, which make food to support the community. Some animals existing in a community eat the plants. Many communities also contain predatory animals that eat other animals. In addition, a community contains micro-organisms that decompose the community's dead organisms and waste products.

In this activity, the focus is on the animals in a community. The youngsters investigate some relatively simple communities by shaking the foliage of trees and shrubs to find the animals that make their homes on the leaves and branches. The kids compare these animals to the animals of a "mystery community" gathered by you *before* the activity. From the results of their own shake downs the youngsters determine which kind of plant yielded the mystery community. Following the shake down, the youngsters observe community interactions using a homemade View Chamber.

MATERIALS

For each student:
1 3" x 5" card
1 Shake-It Container
1 hand lens* or bug box*

For the group:
1 "Shake-It Container" Equipment Card

Additional materials for activity format:
1 roll of masking tape
• a few extra plastic bags
1 large View Chamber
1 data board and marking pen (optional)

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Site and timing. *Shake It!* is an activity for a warm spring or summer day. Select a site with a variety of trees and shrubs with low foliage that youngsters can easily reach and shake. Hardwood forests, stream and pond edges, and brushy areas are all excellent sites. Also, keep in mind that a stiff breeze can make this activity very difficult.

Make up enough Shake-It Containers for every participant to have one. If you plan to use the activity format, make one or two View Chambers. (See the "Shake-It Container" Equipment Card in the *OBIS Toolbox* folio for information on construction and use of both pieces of equipment.)

ACTIVITY FORMAT

CHALLENGE: FIND A COMMUNITY THAT MATCHES THE MYSTERY COMMUNITY BY SHAKING DOWN TREES AND SHRUBS.

PREPARATION

Shortly before meeting with your group, go to the activity site and shake a few plants to familiarize yourself with the animals living on each kind of plant. Select a plant with a nice variety of critters and shake them into a plastic bag. This sample will be the "mystery community." Keep leaves *out* of this bag as they will spoil the mystery for the kids. In a separate bag, place a leaf sample of the mystery-community plant as well as leaf samples from enough other plants for each team to have a different leaf sample.

ACTION

1. Show the group the bag containing

the animals from the mystery community and tell them that these animals make their home in one of the trees or bushes in the area.

2. Define **community** as a group of plants and animals living and interacting in an area. Write the definition on your data board. Tell the group that for the purpose of this activity the animals living and interacting on one plant make up a community.

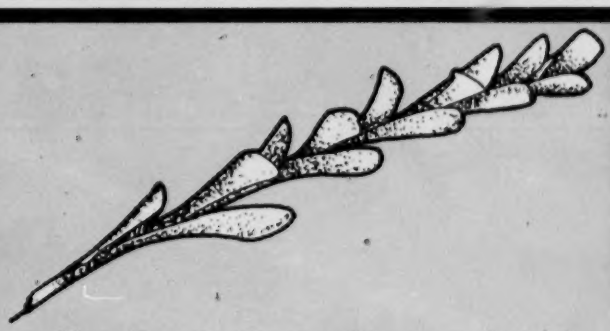
3. Have the group inspect the animals from the mystery community. Let the youngsters use their magnifiers to get a close look at the animals. Tell them that the critters all came from one plant. You may wish to let the kids make up names for the animals and write them on the data board under the definition of community.

4. Introduce the Shake-It Container as a tool for sampling communities of small animals in plant foliage. Demonstrate its use and distribute one to each youngster. Give each youngster a 3'' x 5'' card and demonstrate how to use it to scrape clinging critters into the Shake-It bag.

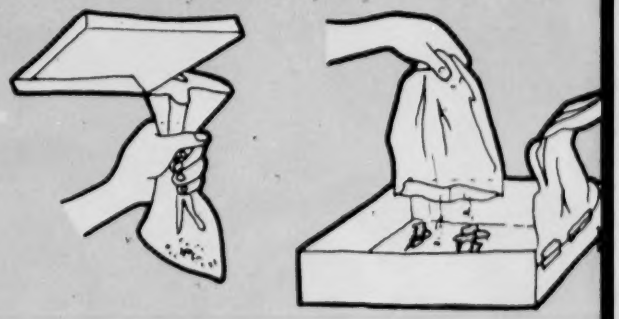
5. Show the group the leaf samples and explain that the mystery animals came from a plant represented by one of the leaves. Let the kids buddy up with a friend and select one of the leaf samples. Challenge them to use their leaf as a clue to help them find their plant. Each team may have to shake several of its kind of plant to gather a good sample of animals.

6. When the teams have shaken down their plants, call them back. Who shook the plant that harbored the mystery-community animals? Compare the kids' animals with the mystery-community animals. Does one sample match the mystery community exactly? Close? Are several other samples similar?

7. Use your View Chamber to further investigate community dynamics. Have each team go back to its plant and collect one branch sample 10 to 15 cm long.



Place these in the chamber, spaced equal distances apart. Have the teams dump their animals into the chamber by removing their bags from their Shake-It Containers and shaking the contents into the view chamber. (See illustration.)



8. Chamber interactions to look for:
   a. Do animals return to the kind of plant out of which they were shaken?
   b. Do some animals seek protected places? Are they camouflaged?
   c. Do the spiders spin webs? Do any animals capture other animals and eat them?
   d. Do any of the animals eat any of the plant samples?

COMMUNITY ACTION QUESTIONS

☐ Which plant seemed to host the richest, most diverse community? How many different kinds of animals were found in that community?

☐ Describe some of the interactions you observed in your community. How do you think these interactions help to keep the community going?

☐ Which community had the most animals? The biggest animal? Smallest?

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Brightest colored? Best camouflaged? Fewest?

☐ Did your Shake-It Container do a good job of sampling *ALL* of the critters on the bushes you investigated? What critters were *not* sampled? (Animals that clung tightly, animals that flew away.)

HIKE FORMAT

CHALLENGE: DISCOVER WHAT KINDS OF ANIMALS LIVE ON PLANTS ALONG THE SIDES OF A TRAIL.

ACTION

1. During a pause at trailside, introduce your youngsters to the Shake-It game. Tell them that lots of animals are within arm's reach on either side of the trail. Challenge them to find some of these animals along the trail. Demonstrate the use of the Shake-It Container and offer it as a tool to help them get a closer look. Distribute 3'' x 5'' cards (for tapping or nudging clinging critters off plants) and hand lenses.

2. When everyone has practiced the technique, challenge the youngsters with some of the following:

a. Pick *one* kind of plant to shake at different places along the trail. Which animals appear time and again on that kind of plant?

b. Have each youngster secretly shake down a good sample of critters from a plant. Let each youngster then challenge a friend to discover what kind of plant was shaken to produce these animals.

c. Show an animal to the group. Challenge the group to find as many different kinds of plants as possible that harbor that animal. When the kids find that animal on a plant, have them take a leaf sample. Then have the group determine if the animal is found on only one kind of plant or common to many kinds of plants. Try another animal.

TRAIL-END QUESTIONS

☐ What kinds of animals were most common on the bushes and trees you shook?

☐ Were many of the animals camouflaged?

☐ Were there any animals that were found on only one kind of plant? Why do you suppose one animal might live on one plant to the exclusion of all others?

FOLLOW UP

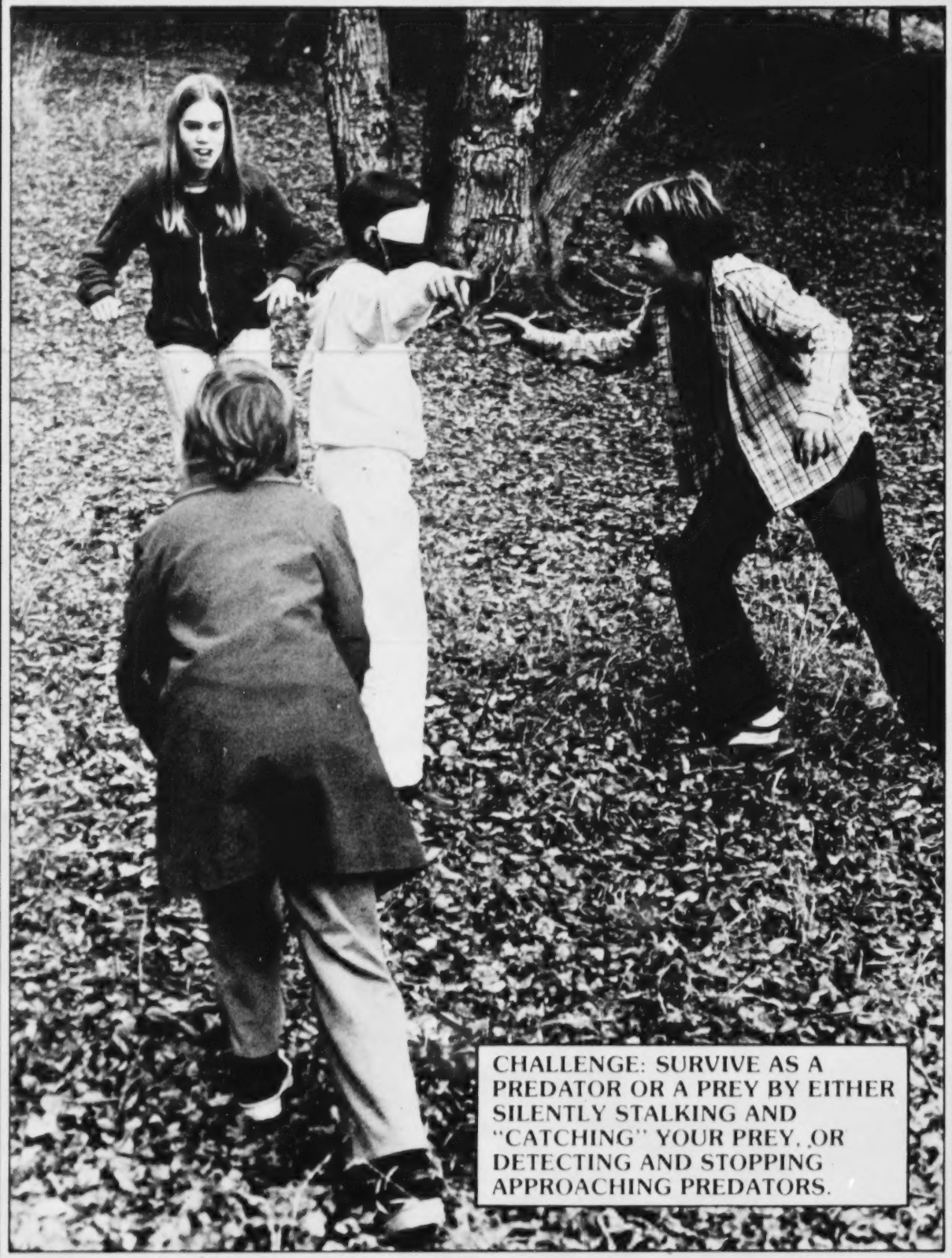
1. Shake some plants at night. Are the nighttime communities the same as the daytime communities?

2. Shake some seaweed or freshwater plants washed up on a beach. Put the animals in some water and observe these aquatic communities.

3. Shake some plants in a vegetable or flower garden (carefully) to discover what animals might be responsible for plant damage.

WHAT TO DO NEXT

Mystery Marauders	Set III
Web It	Set III
Adaptation—Predator-Prey	Set I
Animal Diversity	Set II
Litter Critters	Set II


CHALLENGE: SURVIVE AS A PREDATOR OR A PREY BY EITHER SILENTLY STALKING AND "CATCHING" YOUR PREY, OR DETECTING AND STOPPING APPROACHING PREDATORS.

A mountain lion slowly and quietly approaches a deer until it is within pouncing distance. A wading bird, such as an egret or a heron, stealthily pursues frogs and fish until a sudden thrust of the bird's sharp bill can reach the prey. Many predators must stalk their prey to get close enough to strike without warning. The slightest noise or a sudden movement might alarm the prey and give it an opportunity to escape. The prey must remain constantly on the alert for possible dangers. A good sense of hearing and the ability to pinpoint the direction from which sound comes are important survival adaptations for many prey.

In this activity the participants take the parts of predators and prey. "Predators" must learn to move silently to "catch" the "prey." The prey must rely totally on their sense of hearing to detect and stop the approaching predators.

Silent Stalking works best with four to eight players. If you have more than ten participants, divide them into smaller groups (of no less than four players). The game may be played during the day or night, but night games are more exciting.

MATERIALS

For day use:

1 blindfold or OBIS mask for each group
1 "OBIS Mask" Equipment Card
- cotton or ear plugs

1 roll of masking tape
- several marking pens
- sponges
- string

For night use, add:

1 flashlight with fresh batteries for each group
1 paper cone

Optional:
- flags to mark the stalking site
- extra batteries

PREPARATION

Site. Choose a fairly open, level site (such as a lawn, forest clearing, field, or vacant lot) with a noisy walking surface. Dry leaves and other plant litter make the best stalking surfaces, but you can also use gravel, pebble beaches, and crunchy snow. Mark off a stalking circle at least ten meters in diameter for each group. The edge of each circle should be at least 40 meters away from any other circle.

Masks. OBIS has developed a simple but effective mask for this activity. (The common blindfold often invites peeking.) See the "OBIS Mask" Equipment Card in the *OBIS Toolbox* folio.

Flashlights and Paper Cones. Although some flashlights have a narrow beam, most flashlights must be modified for use in the nighttime version of this activity. A narrow light beam is necessary in order for pinpointing guesses to be clearly identified as hits or misses. You can use an OBIS equipment card or any other stiff opaque paper to make a paper cone for narrowing the light beam. Take a piece of paper about the size of an OBIS equipment card and roll it into a cone from 15- to 30-cm long. The larger opening should fit tightly over the head of the flashlight. Tape the cone to hold it together. Tape the cone on the flashlight in such a way that you obtain the narrowest spotting beam. Carrying an extra set of batteries is advisable.

ACTION

Introduce *Silent Stalking* as a predator/prey game. Define "predator" and "prey" if these terms are new to the group. A **predator** is an animal that catches and eats other animals. A **prey** is an animal that is captured and eaten by another animal. Ask the group for examples of predators that stalk their prey, such as cats, foxes, and owls.

The Silent Stalking Game

Outline the game rules to the participants.

1. One member of the group is the prey; the other members are predators.
2. The prey stands in the center of the noisy walking site and puts on the mask. (Ears should remain uncovered.) At night, the prey also has a flashlight.
3. The predators assemble in a circle about five to eight meters from the prey.
4. When everyone is ready, the masked prey starts spinning around while the predators walk on the perimeter of the circle around the spinning prey. After spinning about four times, the prey yells, "STOP!" Everyone, including the prey, stops.
5. Now the predators silently stalk the prey. The prey protects himself by listening for the sounds of approaching predators and pinpointing them (pointing at them with either the flashlight beam or a finger) before they can get close enought to tag him. The predators must pause between each step to see if the prey has pinpointed them. This prevents a predator from running up and tagging the prey after the predator has been pinpointed. (Since in this game the prey cannot run away, the pause takes the place of an escape response on the part of the prey.)
6. A referee (yourself or a youngster) judges the prey's pointing guesses. When the prey points, the referee yells "Freeze!" and everyone stops. The referee moves behind the prey, sights along the prey's pointing arm, and announces "hit" or "miss." A "hit"

occurs when the prey's flashlight beam or finger points directly at or above an approaching predator. (*Direction* is important here, not height of guess.) "Hit" predators leave the game by moving to a designated area outside of the stalking circle. When a predator tags the prey, the referee also yells "Freeze!" and everyone stops while the successful predator moves outside of the circle. The stalking resumes when the referee yells "Stalk!" Ask the predators outside of the circle to watch the rest of the game *quietly* so the prey can concentrate on pinpointing the remaining predators.

7. The game ends when all the predators have tagged the prey, all the predators have been eliminated, or when the prey has used up all available detection attempts. (Each prey is given twice as many attempts as there are predators.)

Playing the Game

When everyone understands the game, point out the stalking circle(s), select the prey, and let the stalking begin. You may want to run through a practice round. Suggest to the players that at the end of each round the predators who have been detected try to figure out what gave them away.

GAME VARIATIONS

Before playing any variation of the game, ask your group to predict the outcome.

1. Simulate a hearing loss due to injury or age by placing ear plugs or cotton in one or both of the prey's ears.
2. Play the game on several different walking surfaces: a quiet one, a noisy one, a downhill slope, or an uphill slope.
3. Have the predators and prey get down on their hands and feet to simulate four-legged animals.
4. Play the game on a windy (noisy) night.

STALKING TALK

1. Ask the participants how they would change their bodies in order to be more effective as predators or as prey.
2. Ask the most successful stalkers to demonstrate their silent-stalking skills to the rest of the group.

FOLLOW THROUGH

1. Challenge the participants to see how close they can get to a bird, cat, fish, butterfly, squirrel, or lizard. At night they could stalk night crawlers (worms), chickens, owls, frogs, or raccoons.
2. Encourage the kids to watch animals stalking their prey – a cat, bird (stalking insects or worms), or a friend trying to catch fish.
3. In a camp, you might ask campers with cameras to see who can get the closest picture of a given animal. (No telephoto lenses, please!)

WHAT TO DO NEXT

Follow the Scent	Set III
Leapin' Lizards	Set III
Web It	Set III
Adaptation – Predator-Prey	Set I
Attention!	Set I
Food Chain Game	Set II
Sound Off!	Set II

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Swell Homes works best from late spring to early fall with a group of eight or fewer youngsters.

A close look at the stems, twigs, and leaves of plants often reveals unexpected swellings, blisters, and bumps. Many of these structures are **galls.** Galls harbor the growing larvae of many different kinds of parasitic insects. A **parasite** is an organism that lives in or on another organism (the host), and draws nourishment from the host.

Strange as it may seem, galls are *not* built by the insects themselves. Galls are produced by the host plant's reaction to the parasitic insect. After a female insect places one or more eggs into the living tissue of a branch or leaf, the plant reacts by producing the additional tissue that forms a gall. Each type of insect must place its eggs into a specific kind of host plant for the eggs to develop. Scientists who study galls can identify the presence of a specific insect from the type of plant and the size and shape of the gall.

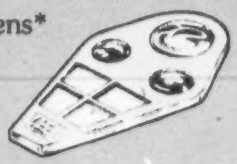
In this activity, youngsters search the foliage of designated plants for swellings and bumps. These swellings are flagged with strips of bright cloth. Samples of the various "swell homes" are then collected and explored to see if anyone is at home. The activity concludes with a search of the area for additional plants with galls.

CHALLENGE: LOCATE SWELL HOMES ON PLANTS IN YOUR SITE. FIND OUT WHO LIVES IN THESE HOMES.

MATERIALS

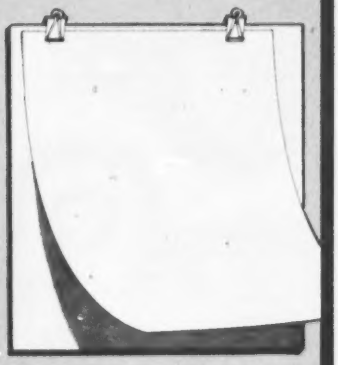
For each kid:
5 strips (3cm x 25cm) of bright cloth

1 bug box* or hand lens*



For the group:
1 or 2 sharp knives
1 pair of tweezers

1 data board



1 felt pen

* Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Locate an area with galls before you conduct the activity. Some plants to check include oaks, elms, coyote brush,

SWELL HOMES

willows, poplars, golden rod, and milk weed. Open a few galls to check for inhabitants. Select one or two different kinds of gall-infested plants for the first part of the activity.

ACTION

1. Introduce the activity with a brief natural history of galls. Tell the youngsters that some insects grow up in homes that are swellings on plants. Parasitic insects place eggs into a leaf or stem of a plant, and the plant forms a structure (the gall) around the developing larvae. The gall provides food and protection for the larvae.

2. Point out the one or two kinds of plants that you want the youngsters to investigate first. Define the limits of the activity area. Challenge the youngsters to locate galls on the designated plants in the area. Hand out five strips of cloth to each kid. Instruct the kids to tie the

colored flags to the plants near swellings or growths that might be homes for small insects. Let the youngsters work in teams of two if they wish.

3. Call the youngsters back after they have searched the area. *As a group,* go from flag to flag, observing the various homes and sharing discoveries. Collect the flags as you go. Have each kid collect one or two samples of swell homes for deeper probing. (Encourage them to remove as little of the plant as possible.)

4. Sit around the data board — it makes a nice work area. Spread out the galls you collected. Ask: "Do you think there could be an animal living in any of these swell homes?" Suggest finding out by cutting some open. Use the knife to cut

Trial Edition
Set III

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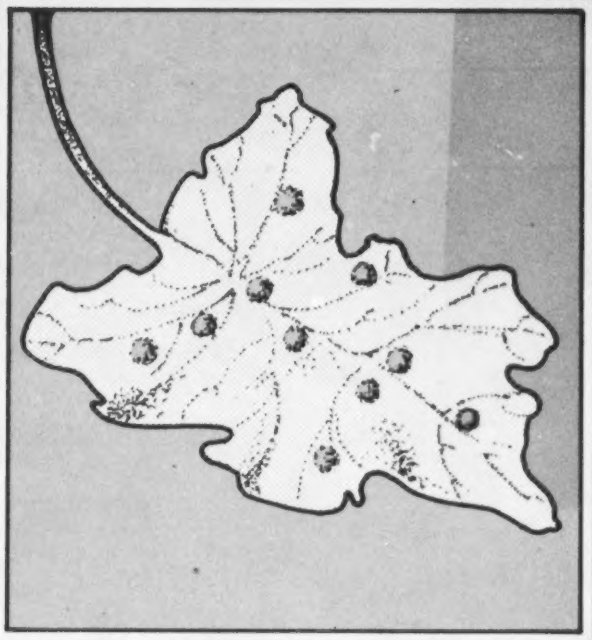
into the galls. You will have to decide whether to let your kids use knives. The activity will be most successful if the kids get to open and probe the galls. Use tweezers to lift out gall occupants for close observation. Bug boxes are excellent for looking at gall dwellers.

5. Move enough galls aside to write the word "galls" on the data board, and have the kids describe the different kinds found. Make up descriptive names, e.g. blimps, blisters, balls, hats, teepees, and cups. How many different kinds did you find on your designated plant(s)?

6. Finally, return to the site to look for galls on plants *other than* those already designated for exploration. How many additional plants have galls?



GALL "BLABBER"

1. Were the homes occupied? Were the occupants in the various galls the same or similar?

2. Do all plants have galls? If not, consider the reasons why some are not hosts. (Aromatic saps, thorns, thick bark.)

3. How do the galls differ from each other? Size? Shape? Solid versus hollow?

4. How many insects live in each different kind of gall? Does this number vary?

5. What benefits do you think gall occupants receive from living in their specialized homes? Food? Water? Protection? Protection from what? Do you think they live there forever? How do you think they get out?

6. Do galls seem to injure or damage the host plant in any way?

FOLLOW THROUGH

1. Take some of the swell homes that you suspect are occupied and put them in a plastic bag. Put in a tiny, moist sponge or bit of wet paper towel or cotton. Seal the bag with a rubber band. Observe the galls for some days or weeks until something emerges.

2. Return to your site. Look for plant abnormalities *other than* swell homes. Perhaps you will find webs, fungi, ants, termites, aphids, curled leaves, dripping sap, lichens, nests, or dead branches. Try to discover causes and effects associated with each observation.

WHAT TO DO NEXT

Mystery Marauders	Set III
Invent an Animal	Set I
Lichen Looking	Set II
Litter Critters	Set II

A close look at any particular physical or behavioral characteristic of organisms of the same kind will reveal differences between individuals. These differences are called **variations.** For example, the number of petals on a daisy varies from flower to flower. The size of the human foot varies considerably from person to person. Are giraffes tall? Yes, but some are taller than others.

A variation can be an advantage, a hindrance, or meaningless to an organism's ability to survive in a particular environment. The extraordinarily tall giraffe has the advantage of being able to feed on leaves that shorter giraffes cannot reach. A daisy with too few petals, however, might not attract the insects necessary for pollination and the production of seeds. Small variations in the size of the human foot may have little effect on a person's ability to survive.

Variation Game introduces kids to the concept of variation between individuals of the same kind. The leader reads three stories that introduce make-believe worlds inhabited by monkeys (youngsters) who must successfully meet various environmental challenges (play simple games) in order to get the resources (represented by toothpicks) necessary to survival. The kids soon observe the natural differences (variation) in their ability to play the different games. At the end of the activity, the leader introduces the concept of **variation.**

CHALLENGE: MEET ENVIRONMENTAL CHALLENGES AND GET ENOUGH RESOURCES TO SURVIVE.

MATERIALS

The materials listed are for a group of ten to fifteen youngsters.

For all the games:
1 box of flat toothpicks or popsicle sticks
1 "Stories" Card
1 "Game Rules" Card
7 5" x 8" cards or other pieces of cardboard
1 watch or kitchen timer
1 data board
1 marking pen

For "Pulling Roots" game:
3 two-meter lengths of heavy rope knotted at each end

For "Building a Shelter" game:
6 bolts, at least 5-cm long
18 nuts that fit the bolts

For "Catching Termites" game:
4 3" x 5" cards
4 sewing needles
1 spool of thread

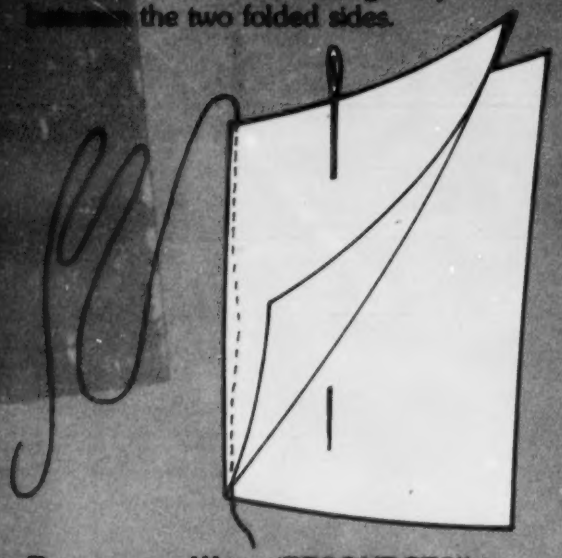
PREPARATION

Site. A lawn or field large enough to handle a group of jumping, screaming youngsters is perfect.

Termite nests (for "Catching Termites"). Fold the four 3" x 5" cards in half. Cut and drape 20 centimeters of thread over one side of each card. (One end of the thread should rest in the fold, and the other end should drape over the edge and hang outside the card.) Poke a needle through both halves of each card. Then pivot the needle so that you can poke it back, making a new hole, through

VARIATION GAME

one side of the card, leaving the point between the two folded sides.



Resources. Write "RESOURCES" in large letters on the seven 5" x 8" cards. Just prior to starting the activity, scatter half as many cards as you have kids around the lawn. Keep the cards about two meters apart. Place about 15 toothpicks or popsicle sticks on each card.

ACTION

1. Have the kids sit around you. Tell them that for this activity they are going to pretend to be animals. Each of the kids will be a monkey (or animal of your choice) trying to get enough resources to live. Explain that resources include food, water, space, and shelter. Point out the resource cards and sticks (representing resources) you have scattered around the lawn.
2. Explain the basic activity rules:
   a. The activity has three rounds. Each round will be introduced by a different story describing a make-believe world the monkeys live in. The monkeys will face three specific challenges in each round.
   b. Each challenge is a simple game played by two monkeys. The winner of the game gets one toothpick and control of the resource card. The loser must challenge another monkey in control of a resource card.
   c. Only a monkey in control of a resource card can be challenged. When challenged, the monkey with the card gets to choose which of the three games he or she wants to play.
   d. The monkeys should play as many games as they can in the allotted time. They should play all three of the games at least once.
3. Read **Round One** of the "Stories" card to the kids. Explain the rules of the three games described in the story. (See the "Game Rules" card.)
4. To start the activity, and for each succeeding round, have the kids count off: "One, two, one, two," etc. Then decide whether the *ones* or the *twos* start off in control of the resource cards. Set the timer for six minutes and let the challenges begin.
5. When the six minutes are up, record on the data board each child's name and the number of toothpicks he won. Then have the kids return the toothpicks to the cards for **Round Two.**
6. Repeat steps 3 through 5 to play the games in **Round Two** and **Round Three.**
7. After all three rounds are completed, have everyone sit around you again. Discuss with the group the special abilities that were required for successfully playing the games in each of the three rounds. List these abilities on the data board. Suggestions usually include:

Round One:	size and strength.
Round Two:	hand coordination and quickness.
Round Three:	good eyes, ability to make good guesses, and skill.

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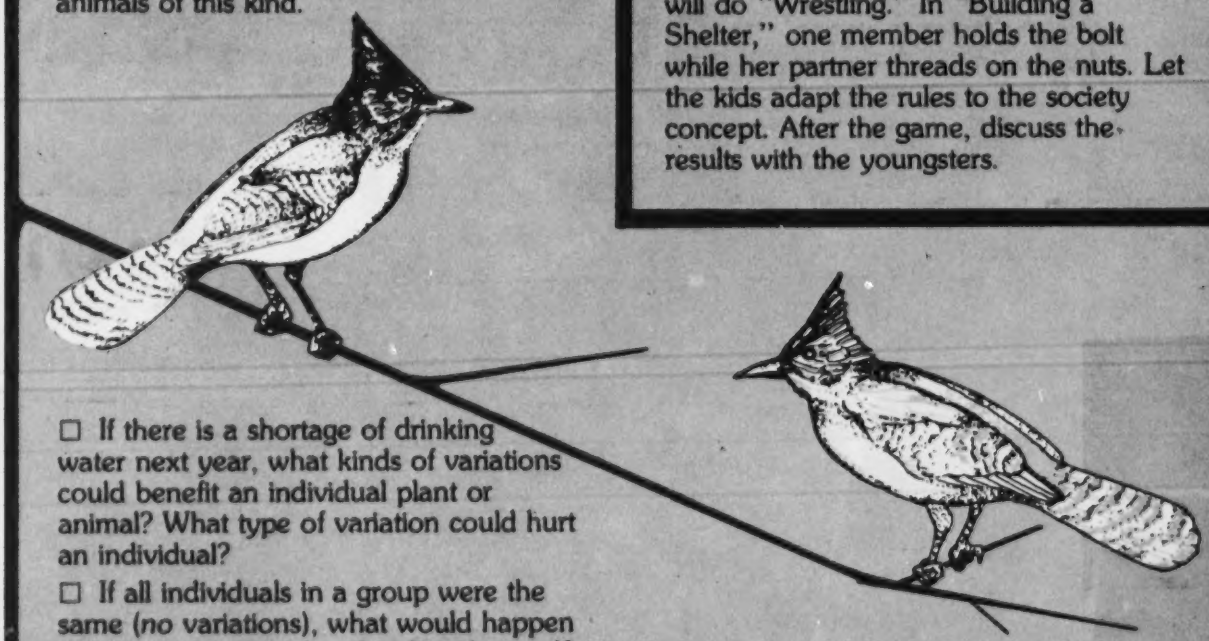
8. Ask the group why different kids were more successful at certain challenges. Responses usually include: the challenges were different, some kids are good at some challenges and not good at others, or kids are different. Emphasize the natural differences, both physical and behavioral, that exist within any group of organisms of one kind. Introduce and define the concept of **variation.** (See the introduction.)

WHAT DO YOU THINK?

☐ Pick *one* familiar animal (blue jay, skunk, or lion). Ask the kids what variations might exist in a group of animals of this kind.



☐ If there is a shortage of drinking water next year, what kinds of variations could benefit an individual plant or animal? What type of variation could hurt an individual?

☐ If all individuals in a group were the same (*no* variations), what would happen if the environment they lived in changed?

☐ In the last part of the activity a housing subdivision eliminated some of the resources the monkeys needed. Ask the kids if they know of nearby areas where animal homes, food, or other resources were lost due to road construction or housing developments.

FOLLOW UP

1. Have your kids make the following investigations of variation between individuals of the same kind.
   a. Count the number of petals on several flowers of the same kind.
   b. Measure the length of several leaves from different trees or shrubs, but of the same kind. Use the millimeter scale on a small ruler.
2. Form teams of two and play the games as "societies" instead of as individuals. Adapt each challenge so that it is for two instead of one. In "Jumping to Escape" total each society's score (the total of the scores from each of the two members of the society) to find a winner. The society can choose which member will do "Wrestling." In "Building a Shelter," one member holds the bolt while her partner threads on the nuts. Let the kids adapt the rules to the society concept. After the game, discuss the results with the youngsters.

WHAT TO DO NEXT

Jay Play	Set III
Invent an Animal	Set I
Food Chain Game	Set II

The place where a plant or animal normally lives is called its **habitat.** Here an animal finds everything it needs to survive, such as food, shelter, and the proper physical environment. Habitat changes, however small, affect the animals living in that habitat. If the change is too great, an animal may be forced to search for a more suitable habitat.

Man often moves animals from one area to another. Black bears, coyotes, and raccoons, when in conflict with people over the same habitat, are often moved to wilderness areas. Restocking of elk, deer, and fish in areas where they are no longer found is another example of relocation. Each time animals are moved, care must be taken in selecting the proper habitat.

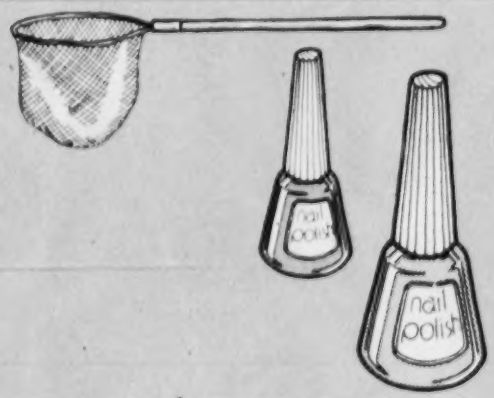
OVERVIEW

In this activity youngsters try to discover the preferred habitat of aquatic snails. At a pond, stream, or lake, teams search for and collect snails. Each team then marks the snails and releases them in a new habitat. The next day the teams return to the site to discover if any of their snails remained in their new habitats.

MATERIALS

For each team of two to three:

1 observation chamber (See the "Aquatic Observation Aids" Equipment Card.)
2 dip nets



1 bottle of brightly colored fingernail polish (different color for each team)
1 marking pen or crayon (same color as polish)
1 clear plastic cup or vial for observation
1 small wooden stake to mark release spots
1 hand lens* or bug box* (optional)
1 set of Action Cards

For the group:
1 "Aquatic Observation Aids" Equipment Card
1 master for Action Cards
1 data board
1 hammer

1 roll of absorbent paper towels for drying snail shells

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

You may want to give your group an introduction to the site before conducting *Water Snails. What Lives Here?* (Set I) provides such an introduction.

Site selection. Choose an aquatic site with lots of snails. Aquatic snails are abundant in the shallow water of ponds, streams, and lakes. Each team will be collecting at least 35 snails. Don't be alarmed at the number; small ponds or streams usually contain thousands of snails.

WATER SNAILS
Action Card

Can a snail walk . . .

. . . umop apısdn

a. in water?
b. out of water?
c. on your thumb?

HINT: Try it.

WATER SNAILS
Action Card

With only *one* foot, how does a snail walk?

HINT: Use a vial or cup you can see through.

WATER SNAILS
Action Card

Can a snail walk . . .

. . . umop apısdn

a. in water?
b. out of water?
c. on your thumb?

HINT: Try it.

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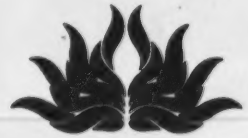
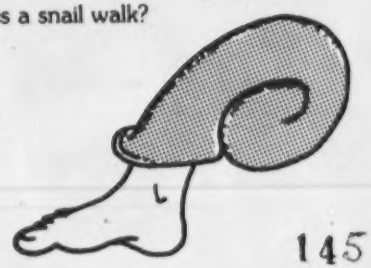
WATER SNAILS
Action Card



With only *one* foot, how does a snail walk?



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HINT: Use a vial or cup you can see through.

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Collecting snails. The youngsters can pick up the snails by hand or with simple dip nets. Snails are not free swimmers; they are usually found feeding on the algae that grow on underwater surfaces. Some kinds of snails can be found feeding on dead plant and animal material in the water.

Materials

1. Duplicate a set of Action Cards for each team.
2. Make a map on your data board of the site you selected.

3. Right before the activity begins, collect a few snails to use in introducing the activity.

ACTION

Collecting Snails

1. Show the group the water snails you collected. Point out the limits of the activity site, and ask the kids where in the study site they think the snails live. Encourage differences of opinion.
2. Introduce and define **habitat.** Read the challenge to the kids and outline the activity. (See the **OVERVIEW** section.)
3. Form teams of two or three and distribute nets and an observation chamber (milk carton) to each team. Encourage each of the teams to collect at least 35 snails, making mental notes on the kinds of places where they find snails. This information will be useful when the teams choose release spots for their marked snails.

Marking Snails

When the youngsters have finished collecting, gather the teams around and show them how to mark snails.

Snail-marking technique. Scatter the snails on a paper towel and allow their shells to dry. You can also use paper toweling as a blotter to speed the drying of shells. Start marking as soon as the shells are dry. Leave the snails lying on the paper towels, and carefully place a *small* dot of polish on the dry shell with the nail-polish applicator. Be careful not to get polish near the opening of the snail's shell. Let the polish dry for five to ten minutes.

Explain that snails can safely remain out of water while marking and drying take place (approximately fifteen minutes).

1. Give each team a different color of fingernail polish, and let the teams start drying and marking the shells. The hard shell of the snail and its ability to survive short periods of time out of the water make the snail ideal for marking. Emphasize, however, that snails should still be handled as gently as possible.
2. Move from team to team, checking that shells are dry before the youngsters apply the polish. Each team should mark

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30 snails for release. The remaining snails will be used with the Action Cards.

3. Discourage handling of the snails for the five to ten minutes the polish needs to dry. While the teams are waiting, distribute the Action Cards. Challenge the teams to spend a few minutes trying to solve the two challenges with their unmarked snails.

4. Have each of the teams share their observations and solutions to the Action Cards.

Releasing Snails

1. After the discussion, have each team select a release site for its snails, i.e. a habitat that most of the snails will stay around. Encourage discussion within the teams on what makes one site a better habitat than another. Considerations might include potential food, shelter, plants, depth, current, and water temperature. Have the teams record (with marking pens the same color as the fingernail polish) their snail-release spots on the data-board map.

2. Have each team release 30 snails at its chosen site and mark that spot by sticking a small wooden stake into the ground close to the release spot. (Each team should also mark its stake with a dab of color to make it easier to locate the next day.) Spend a few minutes watching what the snails do.

One day later . . .

1. At the site, review what the kids did the previous day. Distribute nets and observation chambers, and challenge the teams to recapture their *own* snails. They should concentrate their searching near the marked release sites. Only marked snails should be collected. Allow plenty of time for the teams to search.

2. Have each team count the number of marked snails recaptured and record that number on the data board.

3. Before returning all snails to the site, have the teams each report the number of snails they recaptured, how far they had to go to find their snails, and their reasons for selecting a particular release spot.

WHAT DO YOU THINK?

1. Which team recaptured the greatest number of its own marked snails? What kind of job do you think this team did in selecting a new habitat?

2. Did any team find snails in its area that were marked by other teams? If so, how would you compare the release points of the teams involved?

3. What do you think happened to marked snails that were not recaptured?

4. What do you think happens to snails that cannot find a suitable habitat?

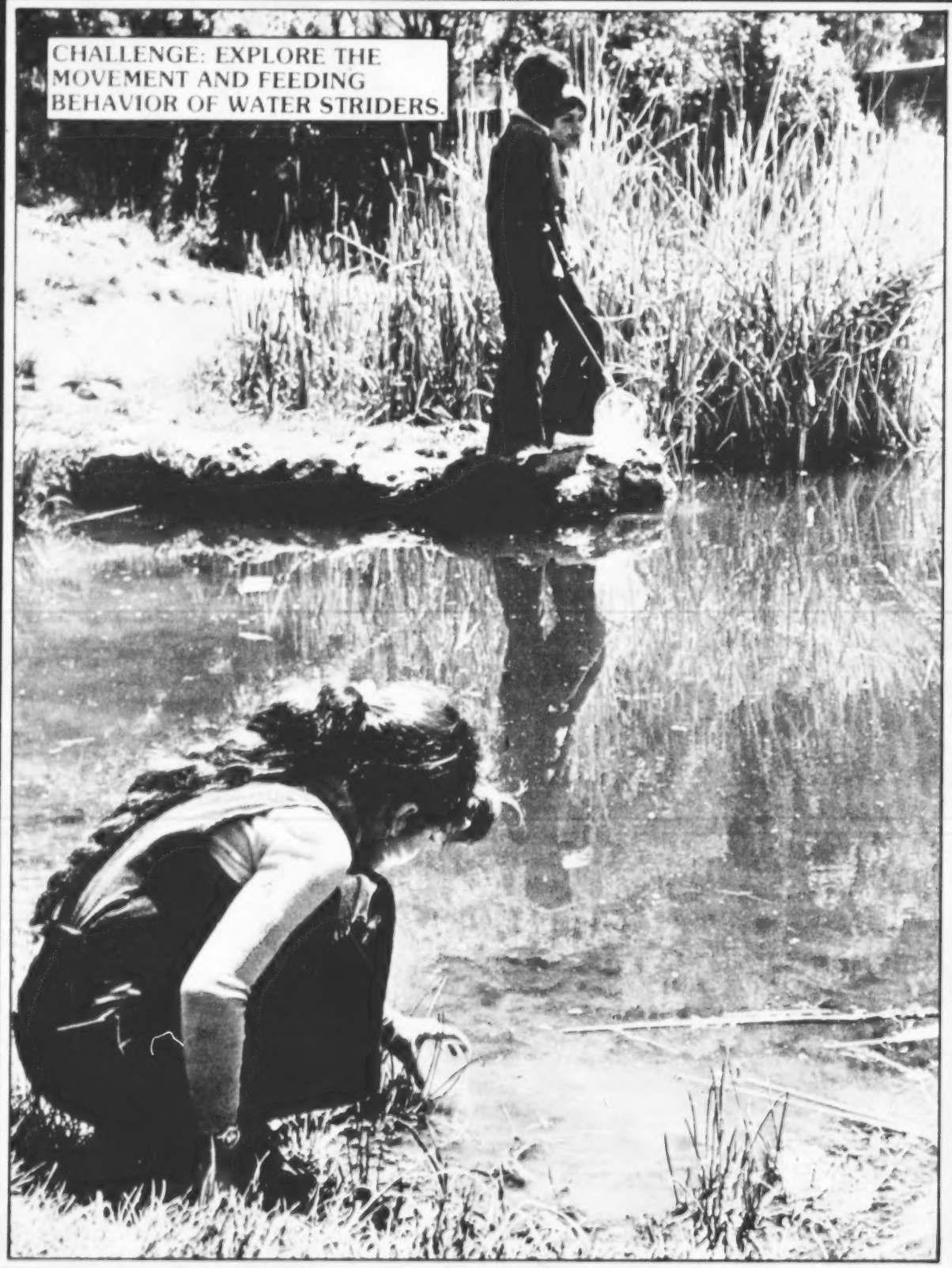
5. What are suitable habitats for people? What are unsuitable habitats? What do people do when their habitats become unsuitable?

FOLLOW UP

Use the mark-and-recapture technique on garden snails.

WHAT TO DO NEXT

Can Fishing	Set III
Hold It	Set III
Habitat Sun Prints	Set I
Habitats of the Pond	Set I
Beach Zonation	Set II
Plant Patterns	Set II


CHALLENGE: EXPLORE THE
MOVEMENT AND FEEDING
BEHAVIOR OF WATER STRIDERS.

The darting movement of the water strider is a common sight at many streams, brooks, and ponds. Striders move across water by using their middle legs like oars and by steering with their rear legs. A strider can walk on water because it has long legs covered with hundreds of tiny hairs that distribute its weight over a large area of water. The surface tension of water supports striders just as it can support a carefully placed sewing needle.

Water striders are voracious feeders, eating insects (dead or alive) and other tiny animals that land on the water's surface. Like all members of the water-bug family, striders have long, thin beaks for mouths. The beak is used like a straw to suck body juices from prey. Striders locate their food both by sight and by their ability to detect the vibrations tiny animals create by struggling to escape from the water. Striders may wait for food to drift by or may actively "skate" across the water searching for food.

Water striders breed during the spring and early summer. During these seasons water striders are often observed pursuing other striders and mating. Mating striders look like they are riding "piggy-back."

MATERIALS

For each buddy team:

1 sweepnet
1 observation chamber (See the "Aquatic Observation Aids" Equipment Card.)
- marking materials (pipe cleaner, bright acrylic or thick tempera paints)

1 bug box* or magnifier*
1 clear plastic cup
2 half-meter-long sticks or flags

For the group:

1 "Sweepnet" Equipment Card
1 "Aquatic Observation Aids" Equipment Card
- several meter tapes or sticks

1 four- to five-gallon bucket (or large dishpan) per 4 to 6 kids

* Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Site. Locate an easily accessible stream or pond with a large population of water striders. If necessary, obtain permission to use the site.

Sweepnetting insects. See the "Sweepnet" Equipment Card in the *OBIS Toolbox* folio. Practice catching and netting insects so that you can demonstrate the techniques to your group.

Techniques: Catching, Marking, and Observing Striders

Catching striders. You must use a quiet, slow approach to get within netting range of the wary striders. Use a quick underhand scoop of the sweepnet. See the "Aquatic Observation Aids" Equipment Card in the *OBIS Toolbox* folio for

instructions on (1) making a hinged-top observation chamber, and (2) transferring netted striders to the chambers.

Marking and releasing striders. Herd a strider into a plastic cup. Dip one end of a pipe cleaner into some acrylic or thick tempera paint, carefully dab a *small* dot of paint on top of the strider's rear end (abdomen), and let the paint dry. To release the strider, tip the plastic cup into the water so the cup slowly fills. Then tip up the bottom of the cup so the marked strider flows out with the water.

Observing striders. Placing striders in a small, clear plastic cup will permit your group to view striders from the side.

ACTION

Catching and Observing Striders

1. Divide the group into buddy teams and point out the limits of the activity site.
2. Announce to the kids that they will be exploring the movement and feeding behavior of water striders.
3. While emphasizing the need for gentle handling, pick up a sweepnet and demonstrate the underhand-scoop method of catching striders. Place a strider in a plastic cup one-quarter full of water, and let everyone see it.
4. After showing the group how to transfer a netted strider into an observation chamber, challenge the teams to catch two striders each. Mention that the buddy without the net can help by herding striders toward the net. Each team will need a sweepnet, an observation chamber, a plastic cup, and a bug box. Show the teams how to use a magnifier or bug box lid.
5. Encourage the kids to observe closely their captured striders by asking questions such as: "How many legs do the striders have? What parts of their legs do striders place in the water for support? Which legs do the striders move with? Are striders wet or dry?

Strider Movement

1. Ask the teams if they think striders tend to stay in one place or travel long distances. Encourage the kids to suggest ways to find out.
2. Explain that a strider's movement is easier to follow if the strider has been marked. Carefully demonstrate the strider-marking technique and have each team mark their two striders. Emphasize that only a *small* dot of paint is needed — no "slopping" the striders with paint!

3. Demonstrate the method for releasing striders with an empty cup. Hand out two marker sticks to each team. Ask the teams to select a spot in the stream or pond from which to release a marked strider, and place a stick at that point.

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4. Explain that when you yell, "Let 'em go!" each team will release *one* marked strider and try to keep track of its movements. Caution the teams about interfering with their striders after releasing them. After five minutes, signal each team to place the second stick at the point where the strider moved farthest from its release point.

5. Hand out the meter tapes or sticks and have the teams measure the distance between the sticks. Call the teams together and compare the traveling distances of the marked striders.

6. Suggest releasing the second marked striders in different spots, e.g. in strong currents, sun, shade, the middle versus the edge of the water. Ask the teams to follow their striders to discover where striders spend most of their time. Have the teams share their findings.

Strider Feeding Behavior

1. Tell the youngsters they are going to bait striders with small insects in order to observe strider feeding behavior.

2. Fill the buckets or dishpans three-quarters full of water. Place about six striders in each bucket.

3. Take the group to a grassy or bushy area and demonstrate the sweepnetting technique. (Shake the net vigorously to remove excess water remaining from netting striders.) Let the teams net some insects and then return (keeping the insects in the nets) to the strider site.

4. Ask the teams to first dunk the netted insects in some water to slow them down. Then have the teams release the insects into the buckets by turning the nets inside out. Insects can also be released directly into the pond or stream near a bunch of striders.

5. Challenge the teams to discover how the striders catch and eat their food. Caution the youngsters to remain still while observing the striders. After the kids have observed the striders grabbing insects, suggest that each team take a closer look at feeding behavior by using a plastic cup to gently scoop up a strider that has caught an insect.

6. After ten to fifteen minutes call the teams together to share their discoveries.

STRIDING AHEAD

Ask the youngsters how they think striders eat. Because this process is difficult to figure out, kids usually come up with some wild answers. In this case, ask the kids how *they* would eat if their mouths were like straws. Then call attention to the strider's beak. Explain that striders jab their beaks into prey and suck out body juices. Ask the kids to look for a strider's beak sticking into an insect.

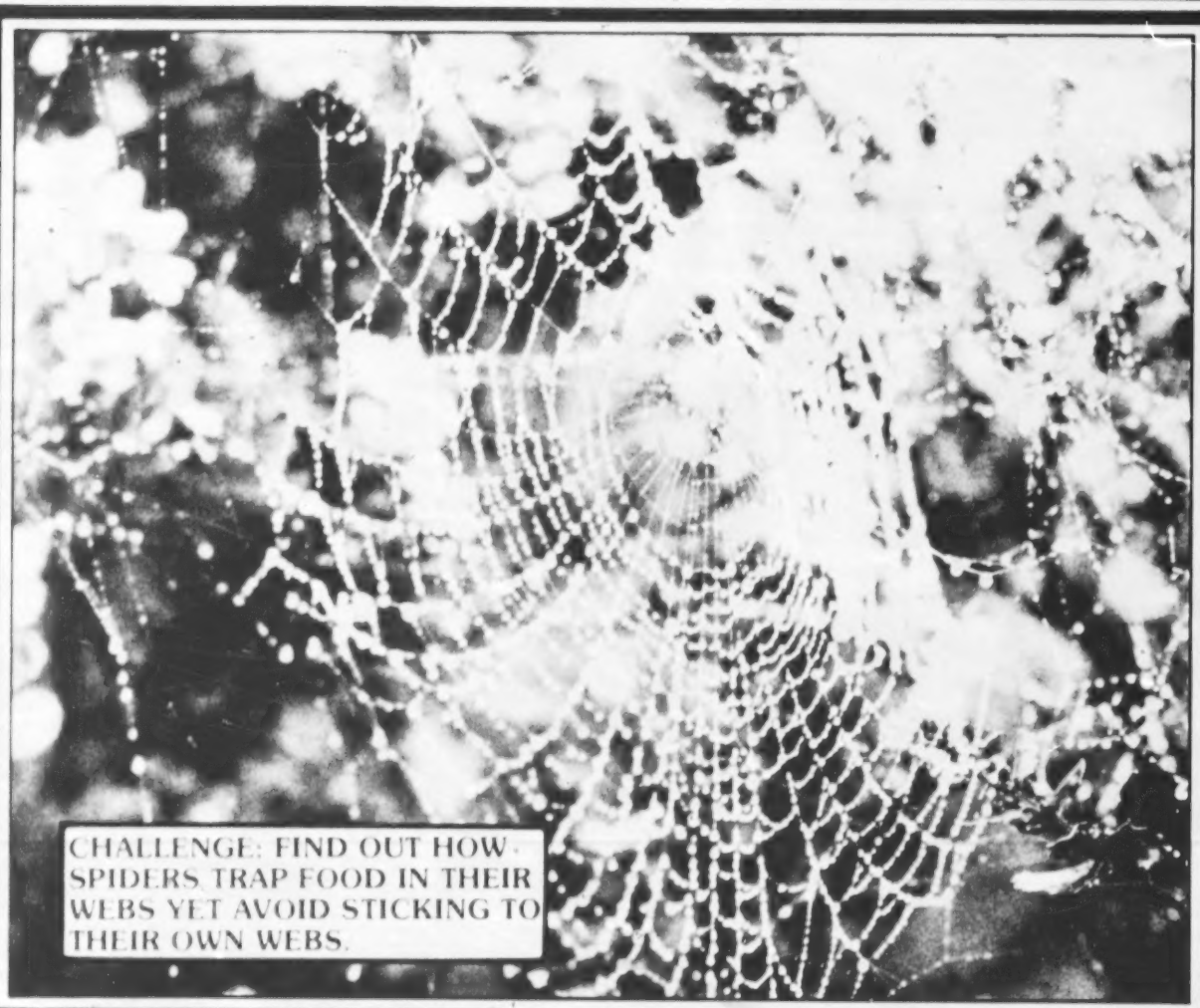
Release the striders at the end of the activity.

STRIDERS REVISITED

Return within a few weeks to locate marked striders. How far have the marked striders moved from the area where they were released?

WHAT TO DO NEXT

Leapin' Lizards	Set III
Water Snails	Set III
Web It	Set III
Great Streamboat Race	Set I
Attract a Fish	Set II
Too Many Mosquitoes	Set II



CHALLENGE: FIND OUT HOW SPIDERS TRAP FOOD IN THEIR WEBS YET AVOID STICKING TO THEIR OWN WEBS.

Most of you are familiar with the cobwebs that often adorn corners of houses, garages, or patios. Broom in hand, you brush the sticky threads away, only to find that they have mysteriously reappeared a few days later. These webs are the skillful work of small, eight-legged predators, spiders, which make their own silk and weave it into traps to catch insects and other small animals for food. The reason that these webs seem to appear from nowhere is that most spiders are active mainly at night. They spend the daylight hours out of sight near the web, unless they are disturbed. (This is a good reason to conduct this activity at night!)

Each different kind of spider prepares a distinctive web trap. There are irregular cobwebs (house spiders), funnel webs (grass spiders), sheet webs, triangle webs, and orb webs. When an insect lands in a web, the spider feels the vibrations on its legs. Each kind of spider has its own method of ensuring that the insect remains entangled. An orb weaver, for example, moves to the insect and draws out more silk from its body to bind its prey. When a spider bites its prey, it injects poison which paralyzes or kills the insect. Juices from digestive glands injected into the prey then liquify the insect's body and the spider sucks the liquid into its mouth.

We do not know for certain what keeps a spider from sticking to its own web. We do know that web-building spiders produce sticky and non-sticky silk. One explanation is that the spider walks primarily on the non-sticky threads of the web. Specialized claws enable web spiders to grasp and crawl on the web threads. Each kind of spider has claws geared to its own type of web. One kind of spider will stick to the web of a different kind of spider.

Although all spiders are capable of producing silk, not all spiders build webs. Some spiders quietly stalk and then attack their prey, while others camouflage themselves in a flower and wait for an insect.

SAFETY

Although most spiders are harmless, you should caution the youngsters against handling the spiders. There is one poisonous web spider the youngsters can easily identify and avoid: the black widow. This spider has a rounded, glossy black body, with an hourglass-shaped red or orange mark on the underside of its body. The shape of this mark varies from spider to spider, and some spiders may have more than one mark.

Top View | Bottom View

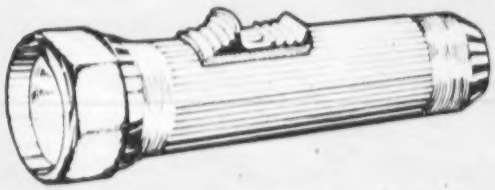
BLACK WIDOW SPIDER

MATERIALS

For each team of two:

- several pieces of flagging (colored ribbon, strips of material, or plastic flagging) to tie on a bush or tape to a rock or building
- piece of masking tape (to tape the flagging to a rock or building)

1 sweepnet
1 plastic bag
1 pair of tweezers
2 broom straws (or other long, thin sticks)
1 magnifying lens* (optional)
1 plastic sprayer ("plant mister" available at hardware or grocery store) with water adjusted to fine-mist spray (for daytime activity), *OR*
1 flashlight (for nighttime activity)



For the group:

1. "Sweepnet" Equipment Card

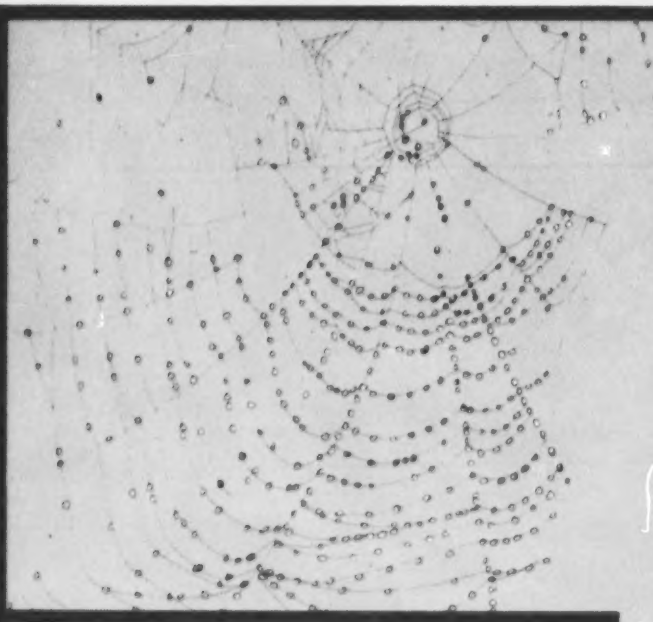
* Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

THE TIME AND PLACE

Web It! is an excellent nighttime activity. Use flashlights instead of the sprayer to locate and highlight webs.

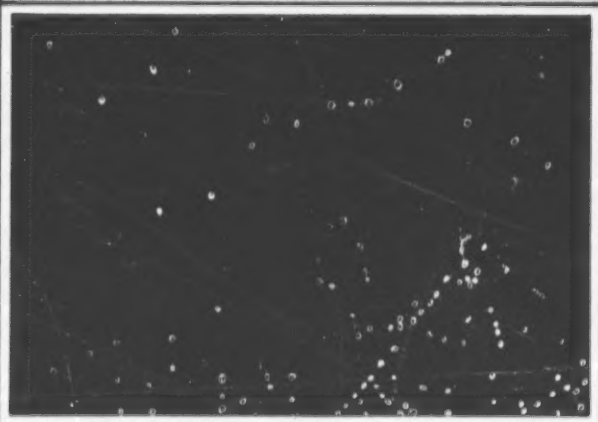
Many spiders are dormant during the winter, so you will have better luck with this activity at other times of the year.

WEB IT



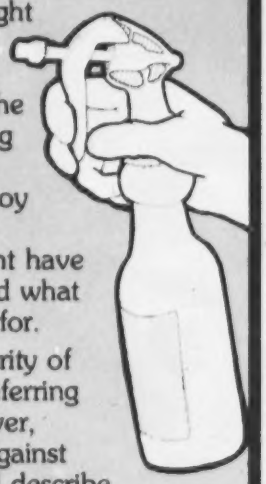
Heavy rain destroys webs, so wait several days after a rain before attempting *Web It!* outdoors. You can use this activity on any kind of day if you have access to an old shed, garage, or other shelter that has webs.

Spiders and webs are everywhere: on buildings, in pipes, on fences, hedges, bushes, and trees, and under outdoor light fixtures. An area that has a variety of potential web sites is best. Survey the area before choosing a location. Practice highlighting and baiting some webs. You can "highlight" a web by spraying it with water (daytime), or shining a flashlight on it (nighttime).



ACTION

1. Take your group to a spot where you have located some webs. Demonstrate how to locate and highlight almost invisible webs by using the sprayer to gently spray the spot with water. (Morning dew provides the same effect). Don't destroy the web with the spray. Ask the group what might have constructed the webs and what the webs might be used for.



2. Explain that the majority of spiders are harmless, preferring running to biting. However, caution the youngsters against handling any spider, and describe the black widow. Show them the illustration in this folio.
3. Limit the activity area and divide the group into teams of two. Challenge the group to find as many different kinds of spider webs as they can in the area. If they find a web with a spider on it, have them mark the location of the web with a flag without disturbing the spiders. Distribute one sprayer and several pieces of flagging to each team and start the web hunt.
4. Circulate among the teams, helping them to locate webs and spiders. Make sure the youngsters don't overspray the webs.
5. After ten minutes (or after a number of spiders and webs have been located), call the teams back and collect the sprayers. Ask the teams to describe or point out to the group the different kinds of webs they found. What shape are they? Where are they located? How big are they?
6. Challenge the teams to find out *what happens when an insect or other tiny animal falls into the web.* Demonstrate

Trial Edition
Set III

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how to catch small insects in grassy, weedy areas by using a sweepnet and how to transfer the catch into a plastic bag. (See the "Sweepnet" Equipment Card.) Also demonstrate how to remove larvae and flying insects from shrubs and trees by placing a plastic bag over a small branch and shaking the branch. Once you have some animals, show the group how to remove an insect from the bag (either using tweezers or fingers) and drop the live insect into the web. The youngsters may have to practice this procedure to be able to successfully transfer the insects.

How does the spider approach the insect? What does the spider do when it reaches the bait?

7. Circulate among the teams and help them bait webs.

8. Offer a second challenge to individual teams or the whole group. *Find out why spiders don't stick to their own webs.* Tell the youngsters they can use a broomstraw or other thin stick to gently touch several different web threads. Ask them to determine which threads are sticky and which are not. Tell them to watch a spider move on a web and see which threads the spider walks on. Suggest that by *gently* touching these threads they can see if these threads are sticky.

WHAT DO YOU THINK?

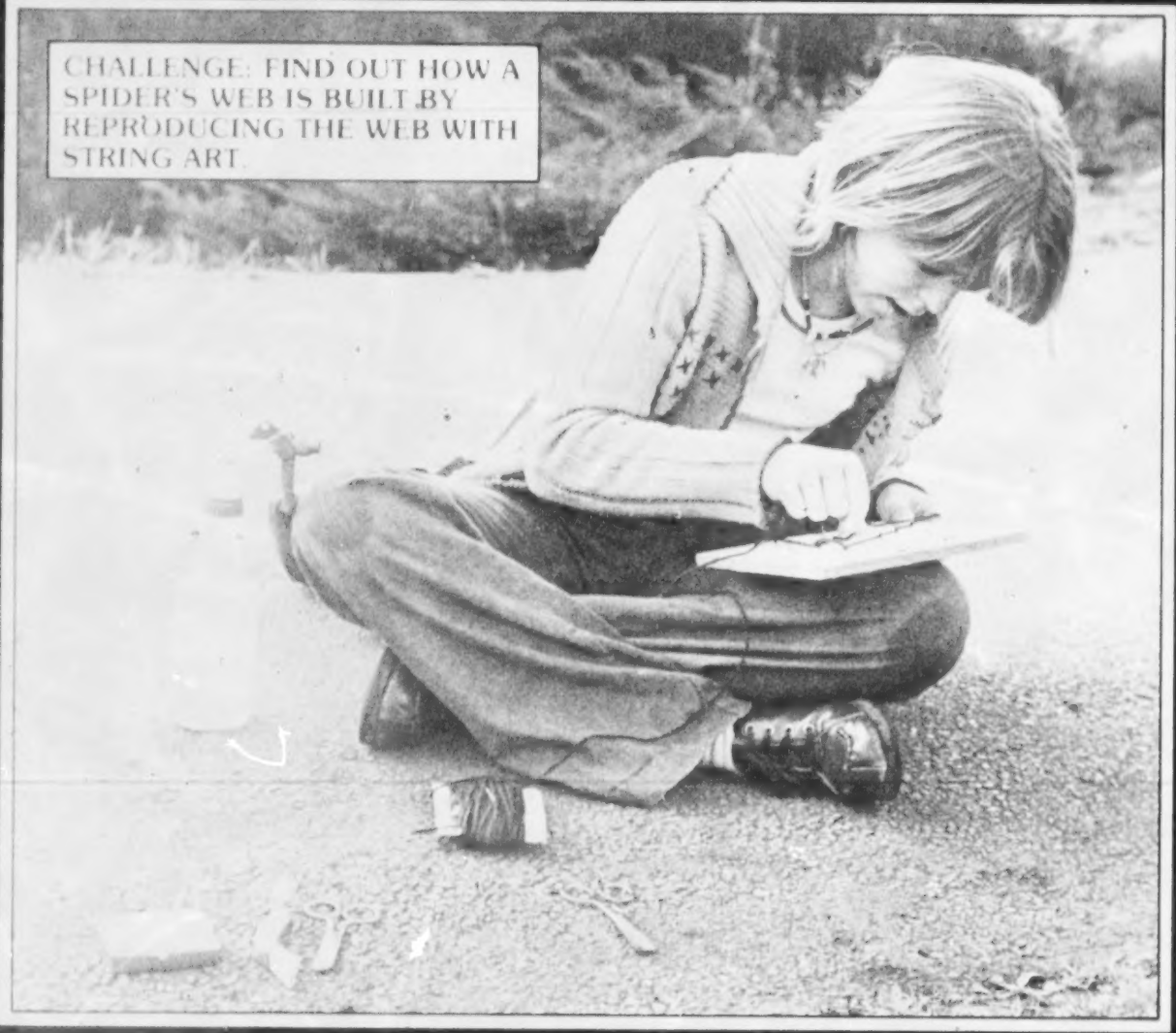
1. What were some of the different shapes of web traps you observed? Where did you find them?
2. How did the spiders react when you baited their webs? Did all spiders wrap their prey? Were there some insects that did not stick in webs?
3. How do you think spiders avoid sticking to their own webs? Might they stick to other webs? Do you think old, unused webs lose their stickiness?
4. What other animals can you think of that build traps to capture prey?
5. Did you see any spiders that had no webs? How do you think they catch food?

FOLLOW THROUGH

Have the kids locate recently constructed spider webs during the day. After dark, they can shine their flashlights through the webs to attract night-flying insects into the webs. Encourage the kids to watch and see what happens.

WHAT TO DO NEXT

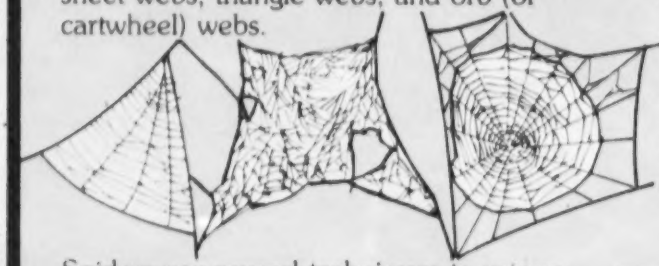
Web Weavers	Set III
Shake It!	Set III
Water Striders	Set III
Adaptation – Predator-Prey	Set I
The Old White Sheet Trick	Set II



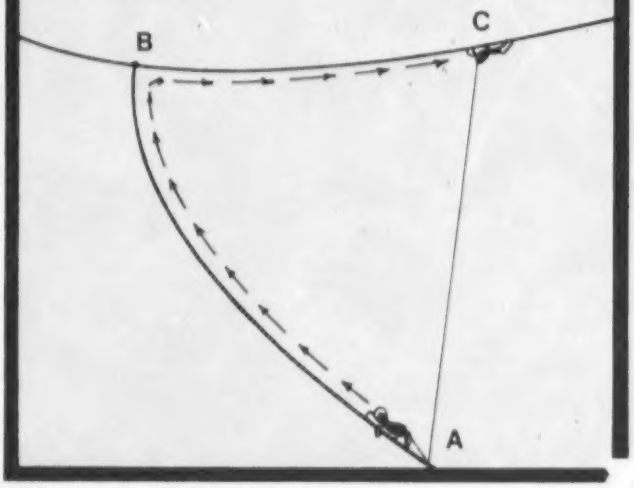
The animal world contains many skilled craftsmen, such as dam builders (beavers), tunnel diggers (moles, gophers), geometric-hive engineers (bees), and mud-nest designers (wasps, swallows). One of the artisans that does very intricate work is the web weaver: the spider!

The spider webs you find will invariably belong to females. Most male spiders do not weave webs but build nests near a female's web. Webs are spun from silk, which the web weaver produces in specialized glands. She releases the silk through openings on her abdomen called spinnerets and handles the silk with tiny claws on the ends of her legs. She may produce more than one kind of silk. Different sizes, textures, and strengths of silk threads are often needed for different purposes, such as: catching prey (sticky silk), building web-foundation lines (non-sticky threads), making nests, spinning egg cocoons, and "ballooning," i.e. riding air currents at the end of a free-floating thread of silk.

Each type of spider weaves a different kind of web than every other type of spider. Two individuals of the same type, however, will weave virtually identical webs. The most common web types are: irregular cobwebs, funnel webs, sheet webs, triangle webs, and orb (or cartwheel) webs.



Spiders use several techniques to weave webs. When bridging the distance between two objects (such as two branches), a spider attaches a thread to one branch and then drops to the lower branch, letting a thread reel out behind her. She attaches the other end wherever she lands. Sometimes a spider spins a long thread and depends on the wind to carry the thread until it reaches and attaches to an object. Often the spider attaches a new thread to an existing thread (point A). She reels out silk behind her as she walks on the existing threads (past point B) to reach a place where she can fasten off the other end (point C). This is how the threads forming the "spokes in the wheel" of the orb web are formed (line A-C in the illustration).



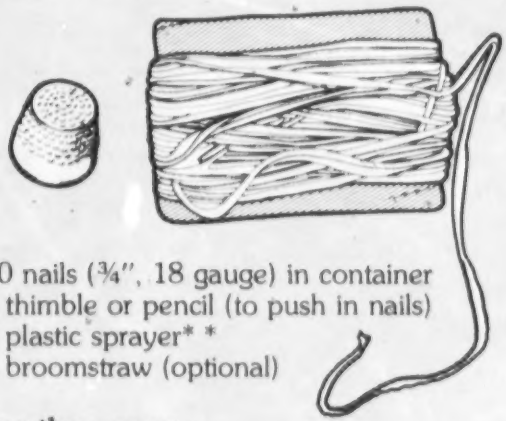
In this activity, youngsters investigate how spiders build their webs by duplicating a web with their own tools.

Special considerations. Many spiders are dormant during the winter, so this activity works best during other seasons. Also, rain destroys webs. Wait several days after a rain before doing *Web Weavers* outdoors. However, if an old shed, garage, or other shelter with webs is available, you can make *Web Weavers* a rainy-day activity.

MATERIALS

For each youngster:

1 20cm x 20cm piece of fiberboard or flat ceiling tile* (soft enough to push a nail into), *OR*
1 20cm x 20cm piece of triwall cardboard
8 meters of crochet thread (wrapped on a small section of cardboard)



60 nails (¾", 18 gauge) in container
1 thimble or pencil (to push in nails)
1 plastic sprayer* *
1 broomstraw (optional)

For the group:

1 "Weaving Webs" Technique Card
3 to 4 pairs of scissors

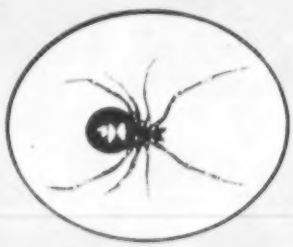
*Available at building supply stores or lumber yards.
* *Available at grocery or hardware stores.

WEB WEAVERS

PREPARATION

Site. Find a site with lots of webs of different kinds. Look on buildings, fences, hedges, trees, shrubs, and outdoor light fixtures.

Safety. Although most spiders are harmless, caution the youngsters against handling spiders. One poisonous spider to look out for is the black widow, which has a rounded, glossy black body with an hourglass-shaped red or orange mark on the underside. The shape of this mark varies from spider to spider, and some spiders may have more than one mark.

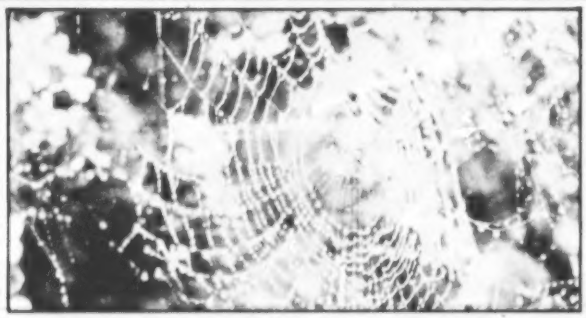


Prepare Materials

1. Cut fiberboard or cardboard into 20cm x 20cm pieces.
2. Wrap an eight-meter length of thread around a piece of cardboard for each youngster.
3. Package nails (60) in containers (envelopes, sandwich baggies, or anything you have available).
4. Fill sprayers with water. (Prepare for water fights!)

ACTION

1. Introduce the activity by telling the youngsters they will be looking closely at an animal's handiwork.
2. At the web site use the sprayer to gently mist the area, demonstrating how to locate and highlight almost invisible webs. Spray above the web so the mist falls down on the web. Be careful not to destroy the web with the spray. Ask the group what might have constructed the web and what it might be used for.



3. Tell the youngsters that they will use this technique to find as many different kinds of spider webs as they can in the area. Warn them not to destroy the webs. Ask them to choose a favorite web for the second part of the activity. Distribute the sprayers and send the youngsters off to locate webs.
4. Allow about ten minutes for the search. Then call the youngsters back to share their discoveries. How many different kinds of webs did they find? Where were they located and what did they look like?
5. Introduce the second part of the activity by asking a few questions: "How do you think a spider builds her web? Does she start in the center and move out or does she begin with the outside frame? How does she get from one corner to another? To what does she attach her silk? (A stem? A leaf? A drainpipe?) Where does she place the

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Set III

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most threads? Is this where animals are trapped?" Explain that these are questions they will explore as they reproduce their favorite webs.

6. Introduce the string-art materials and technique. (See the "Weaving Webs" Technique Card in the *OBIS Toolbox* folio.) Most youngsters will need help with this, so demonstrate the technique step by step. Show the group the simple web illustration on the Technique Card. Ask the youngsters the key questions about the simple web. Use their responses to position the nails in the fiberboard. You will end up with a nail placed at each point where the web is attached to the branches and at each point where two or more threads intersect. These key questions will give the youngsters guidelines to use when reproducing more complex webs.

Key Questions:

a. Where is the web attached to the branches?
b. What is the general shape of the web? Where are the points that outline this shape?
c. How are the threads arranged? Are they all going in the same direction?
d. Where do two threads come together (intersect)? Three? Four?

7. When you have your nails positioned, weave the web with the thread. When the youngsters have the idea, challenge them to relocate their favorite web and discover how it was built by "web weaving" it themselves. (Tell them they will have twenty to thirty minutes for this.)

8. Let the youngsters spread out and work at their own pace. (Some will finish before others.) Check on their progress from time to time and help anyone who may be having difficulty weaving a web.

9. Challenge those who finish early to search for spiders on or near webs. Can they find out where the spiders stay during the day?

TYING UP LOOSE ENDS

When everyone has finished weaving, have the youngsters share their discoveries.

1. What different kinds of webs are represented?
2. How do you think the spider constructed the web you reproduced?
3. What kinds of animals or parts of animals did you find on or near webs? Any spiders? How do you think they got there?

MORE THREADS

1. Give each youngster a broomstraw. Challenge the kids to find out which web threads are sticky and which are not. (A simple touch test with the broomstraw will tell.)
2. Have the kids return to the same site after dark. Bring along flashlights. Have them look at some of the webs. Can they find spiders weaving or eating? How do the spiders react to the light?

WHAT TO DO NEXT

Mystery Marauders	Set III
Web It	Set III
Adaptation—Predator-Prey	Set I
Animal Diversity	Set II

OBIS ABSTRACT

What is OBIS?

Start with a group of young people in the out-of-doors and a biological concept or process as the basic ingredients. Add a large measure of fun; stir in the discovery approach; and season with a simulation, a game, a craft, or an interesting investigation. Mix thoroughly and you have one of the 100 activities that have been developed by the Outdoor Biology Instructional Strategies (OBIS) Project.

OBIS provides community-sponsored youth organizations and schools with learning activities for use at common outdoor sites such as lawns, local parks, city lots, neighborhood streams and ponds, and the seashore. Although the activities are intended primarily for ten- to fifteen-year-old youngsters, both younger and older people (including family groups) have enjoyed OBIS activites. Their easy-to-follow format, simple preparation and equipment, and short duration (usually one hour) make OBIS activities suitable for both the experienced outdoor-education leader and the first timer with no previous experience in biology. The activities may be used independently or sequenced to create a program to suit your needs. Scouts, Park and Recreation districts, religious groups, service groups, nature centers, summer camps, and schools are a few of the groups that have used OBIS activites in their outdoor-education programs. OBIS activities help youngsters and adults to better understand and appreciate the ecological relationships in their local environment.

How Were OBIS Activities Developed and Trial Tested?

The OBIS materials were developed at the Lawrence Hall of Science, University of California, Berkeley, and supported by a grant from the National Science Foundation. The materials were developed over a six-year period ending in 1978. Unlike many development projects, OBIS considered the testing of activities with youngsters to be an integral part of the development process. The OBIS activity development procedure is one of devising a strategy, trying it out numerous times with youngsters, making modifications and then retrying the revised activity. This testing,

revision, and retesting process was repeated on a local level and, in many cases, on a national level for each OBIS activity. To help gather national feedback on the trial edition activities, OBIS established a network of OBIS Resource Centers across the country. Over the past five years, OBIS has received thousands of feedback comments from OBIS users throughout the United States. This feedback is being used to revise the existing OBIS trial editions.

The OBIS Trial Editions are available through the Lawrence Hall of Science, University of California, Berkeley, California 94720.